A

MANUAL

FOR

MANAGERS, DESIGNERS, WEAVERS,

AND

ALL OTHERS CONNECTED WITH THE MANUFACTURE OF TEXTILE FABRICS,

CONTAINING

DEFINITIONS, DERIVATIONS & EXPLANATIONS

OF TECHNICAL TERMS,

THE USE MADE OF MANY SUBSTANCES;

RULES, TABLES, AND SOME ELEMENTARY INSTRUCTIONS FOR BEGINNERS.

BY

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WEST TROY, N. Y., U. S. A.:
A. & A. F. SPITZLI, PUBLISHERS.
1881.

Wm. H. Young,
STATIONER, TROY, N. Y.

ERRATA.

Second word, fourth line, page fourteen, read "weaving" instead of "wearing."

Second line, page 166, read—

●, ∗ and ⊕ for raisers, □ and ○ for sinkers.

NOTE.

The plan of this work necessarily involves the mention of many business names, but its whole value obviously depends upon the entirely disinterested character of that mention. The publishers therefore wish it to be distinctly understood that no consideration of any kind has governed the description or notice of places of business of manufacturers in this work, except the single purpose of giving the reader trustworthy information. Advertisements appear in their proper place as advertisements, but nothing in the body of the work has been influenced by these advertisements, nor is a mention in any instance an advertisement in disguise.

PREFACE.

One of the greatest needs of the Textile Interest in the line of books is that of a thorough and exhaustive Lexicon, which is not encumbered with details of other manufactures. The preparation of such a work is a stupendous undertaking, one for which a lifetime is too short, unless it can be accomplished by aid of many works which have gone before.

To supply a work which will render some such aid, and in the meantime furnish information needed by all connected with the interest, in a form so convenient that it may be resorted to whenever the memory fails to supply a fact with sufficient promptness, is the object of the author.

There has been no effort to introduce new theories; on the contrary, the aim has rather been to furnish the best authenticated facts. While the result is in many parts so unsatisfactory that the author hopes to be able at some time in the near future to revise and enlarge the work, it will be found that space has been made for a more full discussion of the important subjects, by confining others to a simple definition, or at most a few additional suggestions. Time being of great value, the space taken for rules and tables will be appreciated. The rules given are all such as can be easily analyzed, since shorter ways may be adopted more understandingly when these are well comprehended and committed to memory.

The tables will save many computations and prove invaluable for comparisons of measures, weights and values, which are continually arising in a factory.

Finally, feeling that he has not been at liberty to devote to this work the time which it really requires, the author respectfully submits the result of his labors to the most charitable consideration of his fellow-craftsmen, with the firm belief that it will be of much service to them, notwithstanding that it might be more complete.

ALFRED SPITZLI.

INTRODUCTION.

In publishing another book for the benefit of the textile interest, the object is not based upon the vain hope to displace others, or to produce one which will in any way injure any work which has gone before. Quite the contrary is the case with this work, intended as it is to show the use of every book mentioned in it, rather than to deter any one from the purchase of any or all of them. Three principles have governed the compilation of this work:

First. Every book written with a good intent and purpose will do some good.

Second. In this age of progress it is no longer possible to keep apace with the world without much reading for the purpose of acquiring the benefit of other's experience, theories and opinions. Therefore, while it is folly to place sole dependence upon book knowledge, it is ridiculous to claim ability to do as well without books as with them. The interchange of knowledge through books, periodicals and newspapers being a necessity, the more that can be supported the better.

Third. A book of this kind, to be really useful to beginners and experts, should be brief, filled with authenticated facts, convenient in size and arrangement, and of such a character that it will injure no one's standing to claim or acknowledge constant use of it as a reference.

The first and second principles require no comment; in behalf of the third, it is quite proper to call attention to the facts that a book written for the beginner and expert must contain much which for a time will be beyond the beginner, and more which is so familiar to the more advanced that they can hardly comprehend why such "stuff" should be published. To the former we can recommend nothing better than patience, perseverance and a determination to surmount every obstacle; to the latter, patience and charity; with the gentle hint that every man has in his time been brought up solid by snags that afterwards proved but a trivial affair; that what is easy to one is difficult for another; to serve many, the one who serves, must depend upon the served, to bear shortcomings for each other. As regards the convenience of this work, the size and alphabetical arrangement of the subject matter is such as to com-

mend itself. The character of the book, while it gives elementary instructions, is not that of a primer, but rather of a compilation.

The principal contributors to the work are practical men, and the author would have been better pleased had each consented to the publication of his name, instead of honoring him with the result of their labors. The authors quoted and consulted are those of the best and deserved reputation. The books from which abstracts have been taken are "Ashenhurst's Arithmetic," Ashenhurst, Ashton, Baldwin, Barlow, Burns, Gesner, Johnson, Langewald, Murphy and others on Designing and Weaving; Chevreul on Colors; Crooks, Dick, Napier, Gibson, Smith and others on Dyes and Dyeing; Baird, Leigh and Webb on Cotton Yarn Warping, &c., &c.; Holdsworth, Leroux and others on Worsted, Silk, &c., &c.; Ure's Dictionary, several Standard Encyclopedias and general Lexicons have been depended upon for much more general matter pertaining to textile manufactures.

The book which has been thus briefly introduced to the reader is not a single man's opinion but a collection of facts which should be of some service to any and all. Confidently believing such to be the case it is respectfully submitted, with grateful acknowledgement of the great and unexpected encouragement already received by the

PUBLISHERS.

THE MANUFACTURE OF TEXTILE FABRICS.

Whenever or however the conception of a fabric may have originated, a definite idea of kind, character and appearance is the first formal stage in the progress of manufacture, which will serve as a starting point for a general discussion of this subject. From here out the next step is like that of the origination of an architectural piece of work, viz.: to produce working plans which shall include all the specifications of materials required, the preparations thereof, their construction, and finally the finishing process. Such plans are called designs, and one who is competent to produce them, and only such an one, can rightly be called a designer.

No man can claim a full and comprehensive knowledge of all branches of textile manufactures; consequently the best work is produced by those who devote their energies to one branch only; these receive the additional appellation of their respective branches, as carpet, tapestry, silk, woolen, worsted, cotton, print, or embossing designers. Whether the designer of a fabric is entrusted with other duties, or not, he should be able to produce the designs of fabrics in his special line perfect and entire. This is not always called for. There may be certain particulars or specifications in the nature of the goods, or capacity of the factories, with which the design must comply; but the ability to proceed from the beginning should, nevertheless, be possessed before a position is ventured upon. As an instance of limits within which a designer must work, we will cite a factory where only certain kinds of yarn can be produced; the stock and yarn in this case are points already settled, and will appear as such in a design. The ability to make a design which comprehends all the necessities of a fabric from first to last can only exist when a thorough knowledge of the many branches involved is possessed. To supply such knowledge for each branch in print is a task so utterly without limit that every single effort to furnish a share will be but a meagre tithe. Indeed, could all the necessary knowledge be written—an utter impossibility—there would even then remain a necessity for practice in the application, which can be obtained only by practical contact with the work and detail of every branch. Having shown how imperative and extensive the requirements to fit any one for the duties of preparing the designs

of textile fabrics are, it may encourage many to furnish them with a few suggestions. While preparing a design, one must bear in mind that the pecuniary object of a deviation from plain goods is to make a fabric conform to the customs and tastes of the consumers for whom it is intended. To this feature must be added special attractiveness, which pleases the senses of sight and feeling, and sometimes even those of smelling and hearing.

As important as any, if not more so, is the consideration of the cost of materials and labor required. If these exceed the probable value of the fabrics complete, what object can there be in producing them? To exhibit a design, or to run the risk of losing the money? In estimating the probable cost of a piece of goods, the designs for which are about to be made, the necessity of favoring a large production should never be lost sight of; it is a very important feature of manufacturing in this country, and can only be neglected when some other object than profits is in view. To favor production the essential points are: stock that will produce yarn readily, and of sufficient strength to endure the subsequent operations. Stock and yarn which will best produce the desired effects, thus avoiding the manufacture of false effects in finishing, which cost money and are never satisfactory. The matter of conforming the texture to the yarn is of no little importance, especially where the designer's duties are curtailed by specified yarns. A very important requirement of the designer is that he produce designs which can be successfully manufactured by the factory for which the design is intended. This at first seems a needless statement, but a contemplation of the many kinds of goods attempted by the greater proportion of factories in this country, will convince the most incredulous that there is a serious defect in the management of styles and patterns in American mills. The fact must be admitted, however, that designers cause but little of this trouble, that they are but a passive factor, controlled by those who ought to have a knowledge of textures and factories, and often lack them altogether.

As an illustration we have in mind a factory overfilled with machinery purchased for the manufacture of a peculiar kind of goods, but this particular kind having been unfashionable for several years, an entirely different class of goods was introduced. The first class required a firm thread, elasticity was of no great importance, consequently the machinery purchased was such as would produce the yarn in the most rapid manner possible. The yarn now required for the goods in hand should be more perfect, and elasticity is an imperative requisite to make the goods right, and for display-

ing the stock used to the best advantage. In the same factory three-fourths of the looms are so light that all heavy goods are, and must be, woven with the warp very tight—a serious defect—as the contrary should be the case with the above-mentioned fault in the yarn. To show how utterly helpless the designer is here, it becomes necessary to state that the employers have never been able to realize much profit from this mill, consequently, whether they appreciate the impossibility of making the goods right, and to the best advantage or not, they do not feel disposed to spend twenty-five to fifty thousand dollars in applying a remedy. The main source of trouble, however, is in the manager of the goods in the market. A man who seems to be utterly regardless or incapable of comprehending the fact that no mill can make everything; that for some reason every mill sooner or later gets into a sort of rut even with the best conveniences, and once in it, can never be gotten out; in other words each mill seems to be successful with some particular kinds of goods, while others at best prove but an indifferent success. Now, if this particular market man had some knowledge of factories and textures, he would aid the designer in keeping the mill on the styles which are least effected by the consequences of the factory defects. He would long ago have discovered that several very staple styles have been more than satisfactory from this mill, and that $25,000 per annum profit every year from these is better than $50,000 one year and $75,000 loss the next. In other words, he would keep the mill on the fabrics which would build up its reputation and yield a steady though smaller profit, instead of trying to make this factory, too small for fancies, over-crowded, improperly fitted up, supply him with the full assortment he wishes to show, which assortment should be made up by five or six factories instead of one. Carpets are carpets; shawls, shawls; but all silk goods, carpets, shawls, cassimeres, or worsted goods are not alike, nor can all kinds of either be made successful by any one concern.

If then the designs are a want for the conveniences of the factory as much as the factory is needed to carry out the designs, the processes involved should be considered and understood by all who have any authority in relation to the designs and styles used.

The order of processes is something as follows: The selection of the raw material; the separation of the material from matter which must not enter into the goods, and would injure the machinery, yarn and fabric; the color of the stock, if not right, must be made so by dyeing, but this process is in some goods deferred until the yarn or cloth can be dyed. Next comes the preparation

of the stock for spinning, which includes all the processes of carding and combing; also various others of lesser note, but of great importance, which go before spinning; preparing the yarn for weaving, wearing, and finally the finishing of the goods. The last usually includes the cleansing of fabrics, as well as all the subsequent processes.

Silk and cotton are obtainable in such assortments that the stock goes direct from the market to the machinery. Not so with wool and many other animal fibers, which can be procured in market classified or graded only. These grades must be assorted according to their fineness, length and strength, into sorts or qualities, which are usually numbered; they were formerly, and are yet by some, named. This assorting is a branch which requires some months of practice before any one can be entrusted with the work. (See Assorting.)

The stock of the proper kind being ready, the washing and dyeing come next, when necessary, as with wool, hair, etc. Cotton is not washed in the loose state. Silk is treated entirely different from staples in the preparation processes. Before washing or scouring wool, it is by some run through a machine called willow or duster to free it of all dust, sand and short rubbish which can be shaken out. This makes the scouring liquors do more service, and prepares the wool in a measure by opening it for a more ready absorption of the liquors and final rinsing. The methods of scouring and washing are briefly considered under the respective headings.

Some staples are subjected to machinery for opening and clearing of burrs, seeds, etc., etc., in the raw state; others, later in their progress, to the carding department. Several of these methods, as well as the important processes of carding, spinning, weaving and finishing are separately considered elsewhere. The only further reference to them called for here is a special exhortation to give each and all due consideration. No part of them can be slighted or dispensed with if a thorough review and study is undertaken.

Having thus briefly drawn attention to the extent of the field of research to be canvassed by those who wish to be prepared for the duties of the designer, we must leave the matter with these suggestions. The more thoroughly and practically that this preparation is attended to, the easier and better will the subsequent labors prove. It will not do to fear a little grease upon the hands or sweat upon the brow, nor yet some pain in the back, for some things can be learned only when done, and done only at the cost of some discomfort.

A SHORT CHAPTER

OF

SUGGESTIONS TO BEGINNERS.

As in every other art or science, all preliminaries in preparing any one for the duties of a designer or general manager of a manufacturing establishment should have but one aim—to train and discipline the mind, senses and abilities in the proper direction. The powers of concentration and continued application must be acquired by most men, and not a few find it a hopeless battle; yet without such powers some other business would probably answer better. The next important step is to become familiar with a large variety of fabrics already in existence. In pursuing this requisite study, the first suggestions are easily applied. The best method is to obtain samples from every available source, dissect them with care, and use each sample as a base of operations, until all the particulars are obtained. First, by studying out as many as possible; next, by inquiring for the balance. This method will aid the student in asking direct questions, a feature in questioning which is a great help to one who asks and the one who is to answer. Nothing is more discouraging to a tutor than many questions which show a lack of thought on the part of the questioner. Few men can refrain from answering questions which show deep and intent thought, and few care to be bothered with anything trivial. A little further digression will be pardonable here. Young people often flatter themselves with the idea that they are thinking, when in reality they are only dreaming. The difference is so great that the one almost always bears fruit, the other seldom. To obtain samples is a matter so easy that they can at times be collected much faster than properly dissected and studied. Such surplus is not worthless because plenty. Discard worthless samples from the first, and preserve good ones with care.

As each sample is dissected let it be neatly trimmed and fastened in a durable book, all the drafts recorded in another, and all the general information in regard thereto which has been gleaned from any and every source, briefly and correctly recorded in a third, care being taken to keep up a system of numbers and page references

which will make search for particulars of any pattern easy. If any beginner would realize the importance of this suggestion, let him imagine if he can, what he would give for such a collection of books compiled by some man of large experience.

These suggestions are written with the supposition that no one will venture to begin designing without some adequate knowledge of looms. Should this for any reason have been neglected or postponed, it must be delayed no longer after the decision is fully concluded to continue the study.

Good instruments are not only a great aid but much cheer to a beginner; better have a few pieces only, and have such as will warrant a commendable pride. Having good instruments, the next point is to learn their use and application thoroughly. Some have the impression that once in possession of the proper instruments all will be easy, but like everything else, designers' instruments require much practice before their advantages can be known or shown.

Furthermore, designing being a calling which demands cultivation of good taste, this cultivation should show itself in everything; the person, books, instruments and surroundings.

From the earliest beginning the habit of keeping close vigil over all processes by constant examination of goods ready for market is an advantage that should never be missed if available. So complete is the general supervision, that managers have been known to direct the operations of the factory almost entirely from this point of observation with tolerable success. Designing, dissecting, weaving, etc., etc., are treated very minutely in another part; to those parts reference may be made for special points of information.

Far the most common fault in manner and method of beginners is the impatience they exhibit in everything; especially is this true in younger persons. The necessary time to do anything methodically is seldom taken, but the worst phase of this fault is that which shows itself when anyone imagines that rapid work is sure evidence of familiarity with, and special ability for, the work in hand. Such people have more or less deceit in them to commence with, they would appear smarter than their own consciousness allows. The result of such labor is almost invariably faulty, and the whole principle of the method or habit is demoralizing in every sense of the word.

Particularly in designing, or any kindred work, is the old saying applicable, "Anything that is worth doing at all, is worth doing well." Few things in the designing room can be done well without the most thorough preparation. The outside duties, if any, which

compel a designer to slight his work are an injury to him and his employers, hence we contend that manufacturers do not save so much as they imagine when they make one man hold several such positions. The wages of one man for a year is sometimes lost by one neglect, one hurried piece of work, one error. Such losses are attributed to other causes, even by the one who knows better, for fear of consequences; thus manufacturers go on losing money faster than they can save it, at the same time making liars out of young men per force.

To the beginner we would give this advice: Take your time, do your work right, never mind what people say or think, lose twenty positions because too slow, rather than one for errors or bad work, and rather than be one of the many who falsely deny a fault, failing, error or even inability, stay in the humblest position; there is more honor and satisfaction in it. Large salaries, easy positions and great reputations afford no comfort to him who holds his position by trick or deceit. And to employers we would say, treat the young men accordingly, so that they can be upright.

Definition, Explanations and Instructions.

A.

Aba.—A woolen stuff or fabric manufactured in Turkey.

Abaca.—Commonly known as Manila hemp. "A species of fiber obtained in the Philippine Islands in abundance. Some authorities refer those fibers to the palm tree known as the Abaca, or *Anisa textiles.* There seem, indeed, several well known varieties of fiber under this name, some so fine that they are used in the most delicate and costly textures, mixed with fibers of the pine-apple, forming Pina muslins and textures equal to the best muslins of Bengal. Of the coarser fibers, mats, cordage and sail-cloth are made. M. Duchesne states that the well known fibrous manufactures of Manila have led to the manufacture of the fibres at Paris into many articles of furniture and dress. Their brilliancy and strength give remarkable fitness for bonnets, tapestry, carpets, net-work, hammocks, etc." (Ure's Dictionary.)

Abb.—An old English term for warp yarn.

Abol'la.—A military robe of thick woolen stuff in use among the ancient Greeks and Romans.

Acescent.—Substances which have a tendency to pass into the acid state.

Acids.—Acids are a class of chemicals which have the property of combining with and neutralizing the alkaline bases, thereby forming salts. The acids of special interest here are: Acetic, Arsenious, Carbonic, Chromic, Citric, Hydrocyanic, Malic, Muriatic, Nitric, Oxalic, Phosphoric, Sulphuric, Tartaric. These are here mentioned because important factors in tests, dyeing and printing.

Acetic Acid, in briefest terms, is Vinegar Acid. Acetimeter, Acidimeter, Acetimetry and Acedimetry are terms easily confounded; alluded to in this connection, their relations are easily understood. Acetimeter being an instrument for ascertaining the strength of Acetic Acid, an Acidimeter an instrument for determining the quantity of acid contained in a free state in liquids. Acetimetry being the art or method of testing acetic acid, Acidimetry that of testing and estimating acids in general.

Acidulous Salts—All salts containing acids—any saline compound—of which the acetic is the acid constituent, is said to be Acetate. Acetate of Copper is Verdigris, Acetate of Lead and Blue Vitrol.

Arsenious Acid—Arsenic.—The principal use made of it by the manufacturer of textile fabrics is best expressed in the words of Mr. Alfred E. Fletcher in a letter on the uses and advantages of aceto arsenite of copper, commercially known as Emerald Green. In reference to the dangers from evaporations from articles colored with it, he says:

"Were it true that such evaporation or dissemination went on, it would indeed afford just cause for alarm, when we reflect that on the walls of houses in this country (England) are displayed some hundred millions of square yards of paper, most of which carries on its surface a portion of arsenical coloring matter; our books are bound with paper and cloth so colored, cottons and silks, woolen fabrics and leather are alike loaded with it."

Carbolic and Carbonic Acids are easily confounded by those who know nothing of their chemical nature. The former is an oily liquid, colorless, a burning taste, resembles creosote and is obtained from coal tar. Carbonic acid is composed of one part carbon and two of oxygen. In its ordinary condition it is a gas, but may be reduced to a liquid or solid state by cold and pressure. It is given out by animals in breathing, by liquors while fermenting, by the decomposition of all substances, and by the combustion of wood, coal, etc. Water will absorb its own weight of it, and more under pressure; combined with lime it constitutes limestone, or common marble and chalk.

Chromic Acid may be obtained nearly pure by adding to a boiling saturated solution of bichromate of potash as much oil of vitriol as will convert the potash into a bisulphate. Let the whole cool, then wash with a little water, stir well and decant.

Citric Acid in crude crystals is used in calico printing; is manufactured similarly to tartaric acid.

Hydrocyanic Acid is more commonly known as prussic acid.

Hydrochloric Acid.—Chemical name for muriatic acid.

Malic Acid.—The word malic pertains to apples, consequently malic acid is understood to be acid made from the juice of apples. Sometimes recommended by dyers in connection with certain states of fermentation, but not in common use.

Muriatic Acid consists of one equivalent of hydrogen and one of clorine; hydrochloric acid, formerly called "marine acid" or "spirit of salt" because made of sea salt. Much used in dyeing.

Nitric Acid.—Corrosive, contains five equivalents of oxygen and one of nitrogen.

Oxalic Acid may be obtained by the action of nitric acid on vegetable substances. Well washed sawdust, starch, gum, sugar or any others containing no nitrogen, yield the most. Sugar has been commonly used. This is an important acid for dyeing.

Phosphoric Acid is recommended by some authors for many wants of dyers and printers, but is not yet used extensively by the former. Finely ground bone ash, digested with oxalic acid and water, yield phosphoric acid.

Sulphuric Acid, or Oil of Vitrol, was formerly procured by the distillation of dried sulphate of iron called green vitriol. This method is now superseded by the combustion of sulphur with niter. The affinity of sulphuric acid for water is very strong. An interesting illustration is the fact that, when exposed to the atmosphere in an open saucer, it will imbibe one-third its own weight in twenty-four hours. This acid is used in great quantities by dyers.

Tartaric Acid is obtained from tartar. The method would be very simple but for the great variation in tartar or argols.

ADULTERATION.—The debasing any product of manufacture, especially chemical, by the introduction of cheap materials.

AFFINITY.—The chemical term denoting the peculiar attractive force which produces the combination of dissimilar substances. It is often called elective attraction, to distinguish it from corpuscular or cohesive attraction, by which particles of *like* kinds of matter are combined; and because it displays the power of selecting its preferable associates.

AGEING.—The fixing of mordants by age. Instructions may be found in Crook's "Handbook of Dyeing and Calico Printing," pp. 280.

ALBUMEN.—Animal and vegetable. Used in printing establishments, sometimes in sizing and cements. No satisfactory substitute has yet been found for all purposes.

ALCOHOL.—Alcohol is produced by distillation of vegetable juices and infusions of a saccharine nature. Its principal use in factories is that of a solvent. As the amount of water purchased in the lower grades is out of proportion with the range of prices, it is economy to buy the best and add water to suit. The spirits commercially known as wood alcohol serve well for many purposes, and such is the odor and taste that workmen are not so sorely tempted

to imbibe it. Some recommend the addition of methyl to alcohol to prevent its use as a beverage either in full strength or dilluted. This is no injury to the required properties of the spirits. For many colors the addition of a little orange shellac is an advantage.

ALDER (Anne. Fr. Erle. Germ. Aluns Glutinose, Lin.)—A tree, different species of which are indigenous to Europe, Asia and America. The wood of this tree, when properly seasoned, makes the best "Top Rolls" for spinning and drawing frames. The American Elder is another wood—a certain newspaper article to the contrary notwithstanding.

ALKALI.—Potash and soda were for some time confounded together, and were hence called alkalis. Ammonia was subsequently distinguished as the *volatile alkali*, potash and soda being *fixed alkalis.*

ALKALIMETER.—An instrument for measuring the alkaline force or purity of any of the alkalis of commerce.

ALKALIMETRY.—The object of alkalimetry is to determine the quantity of caustic alkali or of carbonate of alkali contained in the potash or soda of commerce.

ALIZARIN OR ALIZARINE (or lizaric acid) is the most important and the most valuable coloring matter contained in madder. It is the only one which yields fast dyes capable of resisting the operation of cleansing. By a series of experiments made by Schützenberger with variously-mordanted cloths, submitted afterwards to dye-becks, containing madder and its commercial preparations, it has been fully proved that in these dyed shades—Turkey-red included—alizerin alone is present. Hence, it is inferred that alizerin pre-exists in the madder-root, and is not a product of any subsequent decomposition. (Ure's Dictionary.)

ALLOY.—Alloy is the proportion of a baser metal mixed with a finer or purer.

ALOE (*Alois*, Fr.; *Glauindes aloe*, Ger.)—In botany a genus of the class *Hexandria monogynia.* There are many species, all natives of warm climates, some furnishing useful fibers, others a dye.

ALPACA (*Alpaga*, Fr.)—An animal of Peru, of the Llama species; also the name given to a woolen fabric woven from the wool of this animal. This fabric is now very successfully made in this country, but the highest lusters are still imported. Fabrics made with other fibers, made to resemble the genuine, are sold under the same name.

Alum (*Alun*, Fr.; *Alaun*, Ger.)—A saline body or salt, consisting of alumina, or the peculiar earth of clay united with sulphuric acid, and these again united with sulphate of potash or ammonia. In other words, it is a double salt consisting of sulphate of alumina and sulphate of ammonia. The common alum crystallizes in octahedrons, but there is a kind which takes the forms of cubes. It has a sour or rather subacid taste, and is peculiarly astringent. (Ure's Dictionary.)

Alumina.—The pure earth of clay, or argillaceous earth. It is the oxide of the metal aluminum, the basis of the aluminous salts, and the principal constituent of porcelain, pottery, bricks and tiles, and not "frequently used in dye houses," as stated in a recent work on dyeing.

Alum, Native.—This term includes several compounds of sulphate of alumina with the sulphate of some other base, as magnesia, potash, soda, the protoxides of iron, manganese, etc.

Alum Shale.—The chief natural source from which the alum of commerce is derived in some countries. It occurs in a remarkable manner near Whitby, in Yorkshire, and at Hurlet and Campsie, near Glasgow.

Ama.—Saxon word for the loom beam.

Amber.—The substance amber is of little account to textile manufacturers, but the word is often used as the name of a beautiful, delicate shade of yellow.

Amianthus.—A mineral in silky filaments, more commonly known as *Asbestus*.

Ammonia.—A chemical compound, called also *volatile alkali*. This substance, in its purest state, is a highly pungent gas, possessed of all the mechanical properties of the air, but very condensable with water. It consists of three volumes of hydrogen and one of azote condensed into two volumes; and hence its density is 0.591, atmospheric air being 1000. By strong compression and refrigeration it may be liquified into a fluid, whose specific gravity is 0.76, compared to water, 1000. Ammonia is generated in a great many operations, and especially in the decomposition of many organic substances, by fire or fermentation. Urine left to itself for a few days is found to contain much carbonate of ammonia, and hence this substance was at one time collected in great quantities for the manufacture of certain salts of ammonia, and is still used for its alkaline properties in making alum, scouring wool, etc. When woolen rags, horns, bones and other animal substances are decom-

posed in close vessels by fire, they evolve a large quantity of ammonia, which distils over in the form of a carbonate. The main source of ammonia now in this country, for commercial purposes, is the coal gas works. A large quantity of watery fluid is condensed in their tar pits, which contains, chiefly, ammonia combined with sulphureted hydrogen and carbonic acid. When this water is saturated with muriatic acid and evaporated it yields muriate of ammonia, or sal ammoniac, somewhat impure, which is afterwards purified by sublimation. (Ure's Dictionary.)

Amorphous (*without shape*).—Said of mineral and other substances which occur in forms not easy to be defined.

Analysis.—The art of resolving a compound, substance, texture or machine into its constituent parts. "Every manufacturer should so study this art, in the proper treatises, and schools of chemistry or mechanics, as to enable him properly to understand and regulate his business." And designers have especial need to study the analysis of the many textures with which they come in contact, as this soon educates the mind to a quick perception of a texture without the long and tedious method of dissecting every pattern entirely. The analysis of colors is a study which properly belongs to the designer as well as the dyer.

Aniline.—An organic compound, which may be procured in several ways: First, when isatine is fused with solid hydrate of potash; second, when to an alcoholic solution of benzine a little zinc and muriatic acid is added; but it is obtained best from coal tar, which is to be distilled in a large iron retort, and the successive products to be separately received, especially the latter and denser ones. This heavy tar oil is to be strongly agitated along with muriatic acid in a glass globe. The acid solution contains the aniline, which, being of an alkaline nature, is called a volatile base. It must be subjected to an operose process of purification with milk of lime, etc., too complex to be detailed here, as no useful application of it in the arts has hitherto been made. Dr. Hofmann has written many elaborate papers upon aniline and its saline combinations.—(Ure's Dictionary). Gibson, in his remarks on "Aniline and Aniline Colors," says: "As a general thing, we find that most of the aniline colors are not soluble in water; the blues are the most insoluble; the violets or purples come next; the reds are sufficiently soluble for dyeing in boiling water. The solvents for most of the aniline colors are alcohol, acetic, sulphuric and tartaric acids. When alcohol is used as the solvent, its proportion we find

variable with the kind of dye or substance it has to dissolve. I find that thirty-five parts of alcohol to one of blue, and twenty-five parts of alcohol to one of violet, are good proportions. The iodine blues, where the iodine has been left (in the colors) will require a less quantity of alcohol to dissolve them, and the same may be said of the violets. All aniline colors will precipitate by adding a solution of tannin (sumach or nut galls) to them, but can be dissolved again in alcohol, acetic acid, or diluted oil of vitriol. There have been several methods adopted to do away with alcohol as a solvent, such as decoctions of certain roots, but these methods have not been very successful. Concentrated sulphuric acid, with or without the aid of heat, will dissolve the aniline blues or violets, and by the addition of a large amount of water it will be rendered soluble in hot water; but if you should have your oil of vitriol too hot when dissolving the blue analine, it will impair their fastness. The soluble blues or violets are colors that have been treated with sulphuric acid to make them more soluble, and I warn dyers against them, as we all know that too much solubility is a detriment to dyeing fast colors, but for yarns and flannels it is not so objectionable. The colors obtained from phenic acid and napthaline are often more soluble than those from aniline. The impurities in aniline are, as a general thing, sugar, salt, arsenic, resinous and tarry substances. Sugar and salt you will find in the reds and violets mostly. To detect this fraud is simple: Put a small quantity of the solid dye in a test tube, then add alcohol and shake it well. Let it stand for a few minutes, then pour it off carefully, leaving the residuum. Add some more alcohol, and so repeat the operation until the dye is all dissolved, when the sugar or salt will be found at the bottom of the test tube; those substances, not being soluble in alcohol, will of course settle to the bottom."

Annealing or Nealing (*Le recuit*, Fr.; *das anlassen*, Germ.)—A process by which glass is rendered less frangible; and metals, which have become brittle, either in consequence of fusion or long-continued hammering, are again rendered malleable.

Annotto.—This shrub was originally a native plant of South America, but is now cultivated in St. Domingo and the East Indies. It is called by botanists *bixa orellana*, and grows to the height of eight or ten feet, and never exceeds twelve feet. The leaves are a reddish brown color, about four inches long. The stems of the leaves are made into ropes by the natives. According to Dr. John, the following ingredients are the composition of annotto:

Coloring and resinous matters	28.0
Vegetable gluten	26.5
Lignine	20.0
Extractive coloring matter	20.0
Matter resembling gluten and extractive	4.0
Aromatic and acidulous matter	1.5
	100.0

Muriatic acid has no action upon annotto. Nitric acid will decompose it and form several compounds. Sulphuric acid gives it a blue color, resembling indigo, but will change from blue to a dark purple. Alkalies give it a clear orange color. Chromic acid precipitates a deep orange tint. Annotto is easily dissolved in alkalies, in which solution it is used in the dyehouse. The alkalies that are most used to dissolve annotto are potash or soda-ash, and, if light shades are wanted some dyers use soft soap in the solution. Some keep a stock of liquor on hand, but I have found it to be better if newly made. My mode of preparing annotto is this: To a barrel of water take fifteen pounds of annotto, four pounds of carbonate of soda, three pounds of soft soap; boil it until the annotto is all in solution (dissolved). The colors given by annotto are fugitive, if exposed to the light and air. Acid or alkalies cannot completely destroy the colors dyed by it. Good annotto is of a lively red color. (Gibson.)

Anthracite.—A variety of coal containing a larger proportion of carbon and less bituminous matter than common coal. (De la Beche.)

Anti-Attrition or Anti-Friction Composition.—Various preparations have been, from time to time, introduced for the purpose of removing, as much as possible, the friction of machinery. Black lead, or plumbago, mixed with a tenacious grease, has been much employed. Peroxide of iron, finely divided haematite, etc., have also been used. The manufactures of the Dixon Crucible Co. of Jersey City, N. J., can safely be recommended for this purpose.

Anti-Friction Metal.—Tin and pewter in different proportions are much used. Babbett's metal, about fifty parts tin, five antimony and one copper, is very common in this country. Another formula for the same composition is: Melt four pounds of copper, add by degrees twelve pounds of best Banca tin, eight pounds of regulus of antimony and twelve pounds more tin. After four or five pounds of tin have been added, reduce the heat to a dull red, then add the remainder of the metal as above. This produces the composition termed hardening; of this take one pound and melt with two pounds

of Banca tin to produce the metal for use, which makes the complete proportions one part copper and two parts of regulus antimony and twenty-four parts tin. Tin, copper and spelter are used. When compositions are too soft they will not do for heavy pressure.

Aqueous Tincture.—Solutions of solids diluted with water.

Archil.—This comes to the dyer in casks containing a violet or crimsoned colored liquor and a large quantity of *weed.* This weed is called *Lichen Roccella*, a species of sea weed or moss; the best sort comes from the Cape de Verde Islands but it is found on the coasts of Sweden, Ireland and Wales. The coloring matters of the lichens are known in commerce as the following: First, as a pasty matter called archil; second, as a red powder called cudbear. The mode of preparing archil is by grinding them to a pulp with water; they are then thrown into liquor containing quick lime and ammonia; after standing a few days both the plant and liquor are put into casks, and it is thus received by the dyer. When it is two years old its coloring properties are fully developed; after that time it begins to deteriorate. It gives very blooming but fugitive colors, and is not much used in woolen dyeing, excepting for blooming mulberries, dahlias, etc., and for bottoming for reds, safflowers and cochineal colors, etc., it gives a depth and beautiful tint to the colors so dyed. In 1857, Mr. Marnas of Lyons discovered a process to make with this dyestuff a color that was beautiful and fast and called the color French Purple; it was produced in the following manner: "Powdered lichens are macerated with lime water, in order to render soluble the coloring matter, which combines with the lime. After filtration, muriatic acid is added, which saturates the lime and causes the coloring substance to separate in a gelatinous state, which is washed and dissolved in hot ammonia. The solution is very slow, as it requires from twenty to twenty-five days, and a temperature of 153° Fahrenheit. The ammoniacal liquid, which has become violet, is then precipitated by chloride of calcium; a purple lake is then produced, which is the French Purple.

Acids change the color to a..	Bright Red.
Alkalies " " "	Blue.
Rock Salt gives it a	Crimson Tint.
Sal Ammoniac	Ruby Red Tint.
Crystals of Tin	Red Tint.
Bi-Sulphate of Copper	Cherry Brown color.

Argols.—Crude Tartar; an acidulous salt from which cream of tartar is made. It exists in the juice of certain fruits, notably the grape; is deposited from wines upon the sides of the casks. The

Germans call it Wein Stein (Wine Stone). It is very commonly used in dyeing, in various forms.

Arras Tapestry.—A line of tapestry fabrics named from Arras in France.

Assorting or "Sorting."—The sorting of various kinds of stock is an important branch of manufacturing. In some staples it is done before the raw material is offered for sale to the manufacturers, but particularly in wools quite the contrary is the case, even the grading or classifying being frequently very imperfectly done in these. The assorting of wool is also the most intricate. When well done it implies attention to the fineness, length, strength, state or condition, and part of the fleece from which it came. For fineness alone it is customary to make from three to eight sorts. For length two to four —according to the work for which it is assorted, or there may be a short, medium and long sort. The assorting for strength is carried on very differently in various places; the most common practice is to throw a tender lock into the short sorts; in some mills they must also be thrown to one grade lower in fineness than if they were full up in strength. This is not a good practice, as a lot which happens to have much tender wool will vary the quality of the sorts too much. When such a lot is purchased it is better to make a strong and a tender sort, to ascertain in what proportions the difference exists, giving the manager an opportunity to control the use of it. The matter of "State or Condition" refers to the health and cleanliness, the impurities being natural grease, burrs, seeds and sand. The part of the fleece from which it came is also considered first in relation to fineness, and then as to condition, for the wool from different parts of the fleece is very different in its nature, some of it being little better than hair. Of assorting wool the fact remains, efforts to the contrary notwithstanding, that it is too important to be slighted by carelessness or false economy. Even work, good work, and increased product, yield a return to which a few pennies per pound are not a comparison, and yet many mills suffer throughout from this evil in the very beginning. Assorting yarn is another important branch in manufactures, but only practical here and there. An experienced hand can assort all the yarn from quite a large factory, detect all that is imperfect, reject that which has been made, and give proper notice that the defect may be corrected and so save thousands of dollars; yet to save $500 or $600 per year this duty is altogether dropped, given into the hands of heedless youth, infirm or blinded age, or perhaps to an overseer who has enough else to do. Assorting waste

should not be neglected in any factory. The wages are returned with a rich increase if this is attended and done judiciously. Assorting rags is a department of some woolen mills as well as paper mills. When shoddy is made this is the first essential process. Dark and light, all wool and part cotton, thick and thin, old and new, must all be separated to attain the best results. Rags containing silk threads are usually thrown with those containing cotton.

ASTRAKHAN.—The name of a country, but sometimes used as a name for yarn made of Astrakhan wool.

AVOIRDUPOIS WEIGHT.—The standard avoirdupois pound of the United States is the weight of 27.7015 cubic inches of distilled water, at 39.83° Fahr., the barometer being at 30 inches.

AVOIRDUPOIS WEIGHT—*Equivalents of in Troy Weight.*

Avoirdupois.		Lbs.	Oz.	Dwt.	Grains.
1 Ton	=	2922	2	13	8
1 Cwt.	=	146	1	6	16
1 Qt.	=	34	0	6	16
1 Lb.	=	1	2	11	16
1 Oz.	=			18	$5\frac{1}{2}$
1 Dr.	=			1	$3\frac{11}{32}$

AVOIRDUPOIS WEIGHT—*Equivalents of in Apothecaries' Weight.*

		APOTHECARIES				
Avoirdupois.		Lbs.	Oz.	Dr.	Scr.	Gr.
1 Lb.	=	1	2	4	2	0
1 Oz.	=			7	0	$17\frac{1}{2}$
1 Dr.	=				1	$7\frac{11}{32}$

AVOIRDUPOIS WEIGHT—*Expressed in Grams or Metrical.*

Avoirdupois.		Grams.		
1 Ton	=	1,015,938.84	=	1,016 Milliers.
1 Cwt.	=	50,796.94	=	5,080 Myriagrams.
1 Qt.	=	12,699.23	=	1,270 Myriagrams.
1 Lb.	=	453.54	=	4,535 Hectograms.
1 Oz.	=	28.34	=	2,834 Dekagrams.
1 Dr.	=	1.77		

AXMINSTER CARPET.—The manufacture of Axminster carpets is a mere modification of the Persian method, for the worsteds are only knotted to the warp threads. They derive their name from a town in Devonshire, but the seat of manufacture has long been removed to Wilton.

AYLESHAM CLOTH.—The linen manufacture became well established in Norfolk, and Aylesham became noted for its flaxen fabrics. "The Fine Cloth of Aylesham," "The Aylesham Linens" and the "Aylesham Webs," are frequently mentioned in old records. English weavers, it is said, knew how to work artificially designed and well figured webs.

B.

Backing.—This word is frequently used as an abbreviation for Backing Fabric, Backing Yarn, etc., etc.

Backing Fabric.—Backing Fabrics are rare, except on woolen and worsted goods. There are many other goods having several fabrics one upon another, not for the purpose of backing, but to keep certain yarns practically out of sight when not needed to complete the face fabric. In other words, parts of all the fabrics are necessary to make the face fabric complete. A backing fabric is merely an addition to increase the weight without changing the face fabric. The elementery principles involved in adding backing fabrics are illustrated under the head of Textures. A few common textures, with a backing filling tacked into the fabric are represented below. Warp yarn may be put in, in a similar manner, but as the yarn is hard, and the number of threads greatly increased, the result is not satisfactory.

Backing Yarn.—Backing yarn is usually made of a cheaper grade of stock, but it will not pay to have the stock so poor as to go bad, whether in warp or filling Neither is it safe to be careless about evenness, twist or color. The matter of uneven backing yarn is serious, because the effects of it usually show through. The trouble may not be so serious if in the warp, but in the filling it is very bad. The makeshift commonly resorted to—more shuttles—is frequently unavailable if the face calls for several also. The matter of twist is quite as important for backing as face. On most goods it should be as soft as possible, and still have the yarn weave good. The color of backing is often of little account in the estimation of manufacturers, but specky, rusty or faded backs will condemn a piece, sometimes even before a customer has seen the face.

Balance of Cloth.—This is a term which is capable of wide interpretation. The general interpretation which is put upon it is the proportion in which the warp and weft stand to each other. But if definite rules were laid down according to this interpretation, one cloth might be perfection, and another cloth, according to the same rule, might be anything but perfection. Yet to all appearance, and for the different purposes to which they were to be applied, and according to the principles upon which the two cloths were constructed, one might be as perfect a sample of a cloth as the other. Again, the interpretation may be a wider one, and it may be said that a properly balanced cloth is one in which the

warp threads are set at a certain distance from each other, according to their diameter and weight, and the proportion of weft to warp which existed in the cloth. This interpretation would be a perfectly correct one, and might be carried out in its entirety, but the particular distance of the threads from each other, or the proportion of weft and warp, which might be taken as a basis, could only be taken for the one particular class of fabric to which it applied, because although that proportion may be all that could be desired for one fabric, experience teaches us that it could not be so for all fabrics, therefore no fixed rule could possibly be laid down which would be applicable to all cases; but, the rule being found for any one class of fabric, it would be applicable to all fabrics of that class. Suppose we are dealing with a plain cloth, in which the warp and weft are both of the same material, and that the warp is so set in the reed that the diameter of the thread and the space between the threads are equal, the weft threads are equal in thickness or counts to the warp threads, and there are the same number per inch both ways. Then the cloth may be truly said to be equally balanced; and whether the material be woolen, cotton or linen, the cloth will be perfect in its construction and will be made on the truest principle. But it frequently happens that to produce special efforts this principle must be departed from. For instance, it may be desired to produce a corded effect, the cord to run either lengthwise or across the piece, a different method must necessarily come into operation. We will wish to make a poplin, in which it is desired to have a decided cordy character, the cords running across the piece; instead of the warp threads having a space between them equal to the diameter of the threads, they must be set very closely together, and the weft threads must be some distance apart, otherwise the clear cord could not be preserved. But although it is necessary that the weft threads be some distance apart, that distance must not be too great or the cord will again be destroyed. Then from this it must be concluded that the warp threads must be set as closely as possible without being too crowded, and the weft threads must be driven as close together as the crossing of the weft threads will permit, and the more carefully this is observed the more perfect will the appearance of the cord be, and this will be materially increased if the weft be proportionately thicker than the warp. But it having been determined what sett of reed for a given count of yarn will produce the best result, it is easy to determine what reed will suit any other count of yarn to produce the same results. Then suppose that the cord, instead of running across the

piece, is intended to run the length of the piece, the procedure will be the reverse of the previous one—that is, the warp threads must be further apart, and the weft as close together as possible; and if the bulk and distance apart of the warp threads be increased, and the bulk and distance apart of the weft threads diminished in a proportional degree, the clearness and boldness of the cord will be increased accordingly, so that in both cases the proposition laid down will hold good. From these two examples another conclusion must be drawn. In the first the warp preponderates largely on the surface of the fabric, and in the second the weft preponderates; and we have seen that as the warp or the weft preponderates it must be increased in quantity, and that which is least seen must be decreased in quantity—that is, in the number of threads per inch. This rule holds good, not only for plain cloths but also for any other make of cloth. If we turn, for example, to twilled cloths, in which some quantity of warp and weft are visible on the face, and in which the warp and weft are of the same material and thickness, then the same rule applies as in plain cloths, viz., that there should be the same number of threads one way as the other. But twilled cloths differ very materially from plain cloths in this respect, viz.: that from the very construction of the cloth the threads must be closer together for the same thickness of thread than for plain cloth, because in a plain cloth the warp and weft threads cross each other, and are interwoven at every pick; whereas in a twill cloth they may pass over a number of threads before they are interwoven; therefore the greater the number which are passed over before the interweaving, the closer or thicker the threads must be to produce an approximate firmness of texture. Hence it is that twilled cloths are so much better adapted for producing heavy, bulky fabrics. In making twilled cloths, the warp or the weft may be made to preponderate on the face of the fabric in two distinct ways:

First—In the same manner as in plain cloths, by bringing the warp threads closer together and putting in fewer picks, at the same time decreasing the thickness of one thread and increasing the thickness of the other, or by increasing the distance apart of the warp threads, and putting more picks, again increasing the bulk of one and decreasing that of the other.

Second—By bringing one or the other more to the surface in the order of working, it must also preponderate in a like degree in the number of threads per inch, or in the actual quantity of the material, and it is only when that is done that the cloth can be properly balanced. We can have no better illustration of this rule

than in some of the best examples of satin cloths, in which the rule will be found to be observed to the last degree. In any cloth in which this is not done, not only will the cloth have an unpleasant appearance, but the effect of the pattern is marred considerably also. These observations apply more especially to fabrics in which the warp and weft are of the same materials, but they apply also to fabrics in which the warp and weft are of different materials; in the latter case, however, attention must be paid to the nature of the material, their density, and their adaptability to blend or assimilate with each other, because the relative proportion of warp and weft, thickness, ends per inch, etc., in one material may be quite correct, if both warp and weft are the same, but if the warp be of one material and the weft of another, then a decided change may take place in their combination. Not only will this be so if one of the threads be vegetable and the other animal substance, but it may be equally so if they are both either animal or vegetable. The combination of a woolen thread with a cotton thread would produce a very different effect from the combination of worsted with cotton, although in both cases it is a combination of animal and vegetable." (Ashenhurst.)

BANDANNA.—A style of calico, in which white or brightly colored spots are produced upon a red or dark ground. It seems to have been practised from time immemorial in India, by binding up firmly with thread, those points of the cloth which were to remain white or yellow, while the rest of the surface was freely subjected to the dyeing operations. The European imitations have now far surpassed, in the beauty and precision of the design, the oriental pattern; having called into action the refined resources of mechanical and chemical science. (Ure's Dictionary.)

BANDING OR BANDS.—The cordage used to drive spindles. All bands on a machine and on like machines in the same factory should be made of the same yarn, twisted and gauged with care. The practice of using all kinds of old odd yarns for bands has caused much uneven work that could not otherwise be accounted for. To keep the tension on bands throughout the machinery perfectly even, and alike, requires constant watching, not by children, but by competent and responsible persons. To renew bands regularly is another necessity if even work is wanted. After many bands are badly worn the difference of new ones (which never draw the same as the old) will soon make bad work. It is better to change the whole set.

BACKING FILLING TACKED INTO FABRIC.

(*See* " BACKING FABRIC," *page* 29.)

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19	*	*	*	*	*	*	*	□	*	*	*	*
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12	*	*	□	□	*	*	□	□
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4	*	□	*	*	*	□	*	*
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	1	2	3	4	5	6	7	8

A

12	*	*	□	□
11	*	*	*	□
10	*	*	□	□
9	□	□	*	*
8	*	□	*	*
7	□	□	*	*
6	*	*	□	□
5	*	*	□	*
4	*	*	□	□
3	□	□	*	*
2	□	*	*	*
1	□	□	*	*
	1	2	3	4

Bar Loom.—The looms known by this name are considered the first power looms that proved successful.

Barwood.—A hard resinous wood brought principally from Sierra Leone. Is of similar nature for use in dyeing as camwood and sanders. Is used in a ground state, gives a permanent coloring matter, with or without mordants, is employed for deep sombre colors and requires much boiling to extract the dye.

Baudekin or Baldekin.—A rich cloth used in Mediæval times, named from Baldak or Bagdad.

Bayeux.—A well known tapestry which was said to have been the work of Matilda, the wife of the Conqueror, and her assistants. Some fabrics having a faint resemblance to the above are occasionally given this name.

Bead Lams and Standards.—Old time mounting of bead harnesses, for gauze or cross weaving, on hand looms.

Bead Loom.—A loom fitted up for cross weaving by means of beads in the harnesses.

Beaming.—This is the process of putting the warp yarn upon beams. When beaming from chains it is necessary to pass the yarn through a set of reeds. With the more recent machinery for warping, chains are dispensed with, consequently this precaution is now seldom necessary except for certain kinds of work. Great care must be taken to lay out the warp just right in width, to fit between the heads of the beams, unless the latter are adjustable, in which case the adjustment is a nice point often neglected. The speed while beaming should be very regular; if not, some fabrics will show the unevenness. Belt slipping is the most common cause of such unevenness in speed, and should be prevented.

Beavers.—Beavers are a class of heavy woolen goods, fine cloth face, and when made right are very nice and durable. The color is an important feature in the attractions of a beaver. Thorough fulling, cropping, boiling and gigging are points in the finish of first-class beavers, which cannot be neglected without injury. The warp should always be of sound stock, not necessarily of the longest staple, but such as will make a strong thread without twisting too hard. The filling, while it should be soft and short stock, must endure much work on the face; the stock used should be selected accordingly.

Bedford Cord.—A ribbed cloth of great strength, commonly drab. Used very extensively for working garments in England.

Beesley's Ribbon Shuttle Motion.—An interesting chapter on Ribbon Shuttles will be found in Barlow's "History of Weaving," pp. 294, which also describes this invention thoroughly.

Beir.—This term, when applied to reeds, represents a certain number of splits—most commonly twenty. Its application to yarn refers to this, 20 splits per inch, and 2 threads per split make the 40 threads called a Beir. (See rules.)

Blanket.—Thomas Blanket was a famous clothier connected with the introduction of woolens into England about 1340. From him the well known name for certain woolen goods is supposed to have been taken. Blanket binding is a term sometimes heard from old men, but they disagree as to the exact texture meant.

Belts.—That the arc of contact has more to do with the driving power of belts than the area, is shown by the wire rope, where the area of contact is so small as to be neglected in calculation, while a large arc of contact is absolutely necessary. Belts have a tendency to sag edgewise and to leave their proper place upon their pulleys. This is more particularly the case with belts transmitting motion between vertical shafts. When two shafts are not in parallel alignment, the belt from one to the other will tend to work off one of the two pulleys. There are four ways of remedying this: First, by properly aligning the shafts; second, by placing unyielding guides at the edges of the belts; third, by using special tighteners; and fourth, by giving excessive crown to the pulleys. When belts are used to transmit motion between vertical shafts, the tendency of the belt to work off is aggravated by its own weight, and this tendency must be met in one of three ways—by throwing the shafts out of correct line, by guiding the edge of the belt, or by the use of special tighteners. Between horizontal shafts the weight of the belt transmitting motion tends to cause or increase adhesion. This is not the case between vertical shafts, the belts of which require to be strained by tighteners. The tighteners may be swinging or sliding, and when properly designed and made, the former should be provided with an adjustment by which the pulley can be moved in the plane of its axis, and the housing piece should be pivoted so that the axis may be given an oblique position. The experiments of J. H. Cooper show that the influence of air upon the belt is simply nothing. The influence of surface upon the adhesion of a belt may be shown by a very simple experiment: Placing pulleys of different diameters in a vice, putting a piece of belting over them, loading both sides alike, and then adding weights on one side till slipping

just commences. It will be seen that on the largest pulley the slip will be least, other things being equal. One experiment of this kind spoken of in the "American Machinist," October 9, 1880, gave the following results: The pulleys used were cones, and the table below gives the distance of slips in one minute:

	Pulley No. 1.	Pulley No. 2.	Pulley No. 3.
Diameter, inches	$12\frac{1}{8}$	$9\frac{5}{8}$	$7\frac{1}{8}$
Distance slips in one minute, inches	$1\frac{3}{4}$	$1\frac{5}{8}$	4

Belts should be wide and long enough to do the work without being run too tight. Uneven speed from slipping belts is bad everywhere. Belts running perpendicularly have to be kept too tight to last long, unless much wider than when running horizontally.

Belt Grease.—That a leather belt should be kept pliable with grease is not doubted, but the kind of grease and manner of applying it, is a question of much controversy. The result desired is not always obtained, because the compounds used are not of a nature to produce it. A list of good compounds might be given, but only one can be tested properly at a time, and such compounds are brought to the notice of manufacturers frequently by other means. Almost every one has used several kinds, observations from which will be useful for comparison. A compound now sold by the Dixon Crucible Co., which is very good, indeed, when judiciously used, should be tried before condemning all kinds of belt grease.

Belt Lace.—For fastening the ends of belts together when they cannot conveniently be lapped and cemented there is as yet no better way than to lace them with a good tough, flexible strip of leather. Rawhide is very good, excepting in places where there is much steam. There are special tannings which do much better in such places, but some kinds of metallic fastenings are preferred by many. To use lacing economically some responsible person should be entrusted with the selection of the sides, also with the cutting, which is done best by machinery; keeping a memorandum of every bunch of lacings given out will soon show by whom and where the most lacings are used, when the matter can be sifted. The greatest waste of lacings may be traced to operatives who will not use them as long, or as many times, as they might. Overseers are usually to blame for slackness in this particular; it devolves upon them to see that laces are drawn instead of cut; and if somewhat worn, or too short, that they are used in his or another department on lighter belts. The trouble is, that few men can mind trifles, when they

belong to others. Could every operative in a mill reduce the waste and loss he causes by carelessness to the lowest minimum, wages might be raised many per cent. and profits be much increased besides. The best way to lace a broad belt is by lacing a lap piece on the outside.

BENZOLE.—Benzine, benzene, benzal, hydruret of phenyle, (C^{16} H^2). The more volatile portion of coal naptha has been shown by Monsfield to consist chiefly of this substance. It is produced in a great number of reactions in which organic bodies are exposed to high temperatures. It may be at once obtained in a state of purity by distilling benzoic acid with excess of quick lime. (Ure's Dictionary.)

BICHLORIDE OF TIN.—Double Muriate of Tin.

BICHROMATE OF POTASH.—Red Chrome of Potash, Chrome.

BI-SULPHATE OF COPPER.—Blue Vitriol, Blue Stone.

BI-SULPHURET OF IRON.—Iron pyrites.

BINDERS.—Many parts of machines or mechanisms are called binders, because they unite or hold in place certain parts, viz.: Box binders or shuttle binders keep the shuttle stationary while in the box. The threads in fabrics which unite textures or tie them down in places are as often called binders as binding threads, which see.

BINDING.—A word used by some in place of texture.

BINDING FABRICS.—Intermediate fabrics used for the purpose of binding others together.

BINDING THREADS OR YARN.—Serving the same purpose as binding fabrics, but in a manner more independent of each other. Some effects on face fabrics are also produced by what are termed binding threads, binding yarn, yarn used for binding threads; also for tying hanks or skeins. The yarn left in the harnesses by the weaver, for the purpose of tying or twisting to it the next warp, to be woven with said harnesses.

BINDING PLANS.—Texture designs on chain and drawing in drafts.

BIRD EYE PATTERNS.—Formerly applied only to a particular little diamond pattern, made with four harnesses, but now applied to any similar effect, made with any number of harnesses.

BLEACHING is the process by which the textile filaments—cotton, flax, hemp, wool, silk, and the cloths made of them, as well as various vegetable and animal substances—are deprived of their

natural color and rendered nearly or altogether white. For some materials the processes are very simple, but others are in themselves a science. The subject is worthy of thorough and extensive study, beginning with the chemicals and their applications.

BOBBINS.—Bobbins are of many shapes and kinds for the many classes of work. To describe shapes would require too much space for the allowance here. Suffice it to say that bobbins should be plenty about a factory, the place for storing them convenient, dry, and large enough so that no box need ever be heaped. From heaping boxes some bobbins fall, only to be trodden under foot or picked up and thrown in the wrong box. The wood, which wears rough, splits easily, warps, or is too soft, is not cheap at any price. The best are the cheapest. Steaming yarn on the bobbin may be necessary, but it is destructive to the latter beyond all other wear and tear. Bobbins should fit all the spindles upon which they must be used; if not, they will be split either by stuffing if too large, or abuse if too small.

BOILERS.—Of the many kinds of boilers used about factories, those which generate steam for power and heating are of the most importance. Boilers for yarn cloth and bleaching are known by more common names.

Boilers (Land) should be set at an inclination of .5 inch in 10 feet.

Grates (Coal).—They should have a superficial area of 1 square foot for every 15 pounds of coal required to be consumed per hour, at a rapid rate of combustion, and they should be set at an inclination toward the bridge wall of 1 inch in every foot of length. When, however, the rate of combustion is not high, in consequence of the low velocity of the draught of the furnace, or the fuel being insufficient, this proportion must be increased to 1 square foot for every 12 pounds of fuel. With *Wood* as the fuel, their area should be 1.25 to 1.4 that for coal. The width of the bars should be the least practicable, and the spaces between them from .5 to .75 of an inch, according to the fuel used.

Ash-pit.—The transverse area of it, for a like combustion of 15 pounds of coal per hour, should be .25 the area of the grate surface for bituminous coal, and .33 for anthracite. The velocity of the current of air entering an ash-pit may be estimated at 12 feet per second.

Furnace or Chamber (Coal).—The volume of it should be from 2.75 to 3 cubic feet for every square foot of its grate surface.

(*Wood.*) The volume should be 4.6 to 5 cubic feet. Combustion is the most complete with firing or charges at intervals of from 15 to 20 minutes. The volume of air and smoke for each cubic foot of water converted into steam is from coal 1780 to 1950 cubic feet, and for wood 3900.

Bridge-wall (Flue boilers).—The cross section of the flues or tubes should have an area of 1.7 to 2 square inches for each pound of coal consumed per hour, or from 22.5 to 26 square inches for each square foot of grate, for a combustion of 13 pounds of coal per hour; the difference in the area depending upon the character of the conformation of the section of, and the length of the passage of the gases; the area being inversely with the diameter, and directly as the length of the flues, tubes or spaces between them. Thus, in Horizontal tubular boilers, the area should be increased to 27.5 and 31 square inches; in Vertical tubular, to 32.5 and 36 square inches; and when a Blast is used, the area may be decreased to 15.5 and and 20.5 square inches. The temperature of a furnace is about 1000°, and the volume of air required for the combustion of 1 pound of bituminous coal, together with the products of combustion, is 154.81 cubic feet, which, when exposed to the above temperature, makes the volume of heated air at the bridge wall from 450 to 470 cubic feet for each pound of coal consumed upon the grates. Hence, at a velocity of the draught of about 36 feet per second, the area over a bridge wall, required to admit of this volume being passed off in an hour, would be .5 of a square inch, but in practice it should be 2 square inches. When 13 pounds of coal per hour are consumed upon a square foot of grate, 13x2=26 square inches are required, and in this proportion for other quantities. The temperature of the heated air at the end of the flues should be about 500°, and their area, and that of the base of the chimney, should be .75 of that over the bridge wall, or 1.5 square inches for each pound of coal consumed per hour. When the area of the flues is determined upon, and the area over the bridge wall is required, it should be taken at from .7 to .8 the area of the lower flues for a natural draught, and from .5 to .6 for a blast.

Flues.—Their area should decrease with their length, but not in proportion with the reduction of the temperature of the heated air, their area at their termination being from .7 to .8 that of their *calorimeter* or area immediately at the bridge wall. Large flues absorb more heat than small, as both the volume and intensity of the heat is greater with equal surfaces. The temperature of the base of the chimney, or the termination of the flues or tubes, is esti-

mated at 500°; and the base of the chimney, or the *calorimeter*, should have an area of 1.33 square inches for every pound of coal consumed per hour. With tubes of small diameter, compared to their length, this proportion may be reduced to 1 inch. The admission of air behind a bridge wall increases the temperature of the gases, but it must be at a point where their temperature is not below 800°.

Evaporation.—One square foot of grate surface, at a combustion of 13 pounds of coal per hour, will evaporate 2 cubic feet of salt water per hour. A square foot of heating surface, at the above combustion of fuel, will evaporate from 4.33 to 5.33 pounds of salt water per hour; and at a combustion of 40 pounds of coal per hour (as upon the Western rivers of the United States), from 10 to 11 pounds of fresh water, exclusive of that lost by blowing out from the boilers. Twelve to 15 square feet of surface will evaporate 1 cubic foot of salt water per hour at a combustion of 13 pounds of coal per hour per square foot of grate.

The relative evaporating powers of iron, brass and copper are as 1, 1.25 and 1.56.

Water Surface.—At low evaporations, 3 square feet are required for each square foot of grate surface, and at high evaporation 4 to 5 square feet.

To compute the heating and grate surface required for a given evaporation, or volume of cylinder and revolutions:

OPERATION.—Reduce the evaporation to the required volume of cylinder, number of revolutions of engine, pressure of steam and point of cutting off; then reduce these results to the range of consumption of fuel per square foot of grate, pressure of steam, and number of revolutions given for the several cases at pp. 593 and 594, in Haswell's Engineers' and Mechanics' Handbook, and multiply them by the units given for the surfaces required. (*Note.*—The work just referred to should be in every manager's possession.)

ILLUSTRATION.—There is required an evaporation of 492.24 cubic feet of salt water per hour, under a pressure of steam of 17.3 pounds per square inch, stroke of engine 10 feet, cutting off at $\frac{1}{2}$ stroke, revolutions 15 per minute, and consumption of fuel (coal) 13 pounds yer square foot of grate per hour, in a marine boiler having internal furnaces and vertical tubes.

Volume of steam at this pressure compared with water, 833.

$492.24 \times 833 \div 60 = 6833.93$ cubic feet of cylinder per minute.
$6833.93 \div 15 \times 2 = 227.79$ cubic feet of cylinder at half stroke.

Then $\dfrac{227.79 \times 17.3}{20} = 197.04$ cubic feet at 17.3 lbs. pressure, and

$\dfrac{197.04 \times 15}{20} = 147.78$, which $\times$ 66, the unit for heating surface for a vertical tubular boiler at 20 lbs. pressure and 20 revolutions$=9753.48$ square feet.

And $147.78 \times 2 =$ the unit for grate under like condition$=295.56$ square feet.

To compute the consumption of fuel in the furnace of a boiler. The dimensions of the cylinder, the pressure of the steam, the point of cutting off, the revolutions, and the evaporation of the boilers per pound of fuel per minute being given :

RULE.—Ascertain the volume of water expended in steam, and multiply it by the weight of a cubic foot of the water used ; divide the product by the evaporating power of the fuel in the boiler under computation in pounds of water, and add thereto the loss per cent. by blowing off.

Boiler Plates and Bolts.—Tensile strength of wrought iron plates and bolts ranges from 45,500 to 62,500 pounds per square inch for plates, 59,000 for English bolts, and 65,000 for American, being increased when subjected to a moderate temperature. The mean tensile strength of steel plates and bolts ranges from 80,000 to 96,000 pounds. Kirkaldy gives 85,966 as a mean.

Bursting and Collapsing Pressures.—The computation for plates and bolts should be based, so far as may be practicable, upon their exact tensile strength. Whenever, then, the strength of plates is ascertained, there should be deducted therefrom one-half for single riveting and three-tenths for double riveting, and the remainder divided by a factor of safety of three. When the exact strength can not be ascertained, a factor of six should be used both for plates and bolts. The resistance to collapse of a flue or tube is much less than the resistance to bursting ; the ratio can not well be determined, as the resistance of a flue decreases with its length, or that of its courses. With an ordinary cylindrical boiler, 4 feet in diameter, single riveted, 20 feet in length, with flues $15\frac{1}{2}$ inches in diameter, shell $\frac{5}{16}$ thick, flues $\frac{1}{4}$ inch, the relative strength are : Bursting, 350 pounds ; collapsing, 152 pounds.—*Haswell.*

Heating Feed-Water.—As some doubts seem to exist among steam users about the advantages of heating the feed water, it might be appropriate to give a few figures about the economy to be obtained thereby. To heat a pound of water from zero to the boiling point, and convert it into steam at a certain pressure, a certain amount of heat has to be imparted to it. A "unit of heat" is the amount necessary to raise one pound of water one degree in temperature. Then

At 15	pounds	above atmosphere	1191	units	are necessary.
" 30	"	"	1198	"	"
" 45	"	"	1203	"	"
" 60	"	"	1208	"	"
" 75	"	"	1212	"	"
" 90	"	"	1214	"	"

Taking 1,200 as an average, and assuming the average natural temperature of water at about 50°, we have to impart 1150 units of heat to every pound of water to convert it into steam. A feed-water heater will thus, for every 100° the feed-water is raised in temperature, effect a saving of

$$\frac{100 \times 100}{1150} = 8.7 \text{ per cent.};$$

the greatest economy would be attained if the feed could be heated to the boiling point. Taking the latter at 212°, the gain would then be

$$\frac{(212 - 50) \times 100}{1150} = 14 \text{ per cent.}$$

In condensing engines the feed-water is taken from the hot well, which generally is kept at 120° to 130°, as a higher temperature would impair the vacuum, and thus neutralize what is gained by a higher temperature of feed. In some marine engines the feed-water has been heated to a higher degree by taking it from the hot well into the top of the condenser, or around and through the exhaust pipe, to expose it to the steam coming out of the cylinder, before it is condensed. Considerable gain has been claimed by inventors of these plans, but as they have not been adopted to any extent it may be doubted whether their advantage is universally acknowledged. For stationary condensing engines the so-called economizers have found extensive application; they consist of coils or rows of tubes, located in the back flue of the boiler; the feed-water is forced through them, and can thus be heated to very near the boiling point. Some of these were shown in the British section, in the

southeast corner of Machinery Hall, in the Centennial Exhibition, and very elaborate and costly structures they were. Their vertical tubes had a slow-moving set of scraping rings around them, to keep them from any soot that might impair their conductive power. Taking the temperature of the hot well at 120°, and assuming that the feed is heated to 200, the gain would be

$$\frac{(200 - 120) \times 100}{1200 - 120} = 7.4 \text{ per cent.}$$

For non-condensing engines, where the feed would have to be raised from 50, the gain would be

$$\frac{(200 - 50) \times 100}{1200 - 50} = 13 \text{ per cent.}$$

For non-condensing engines the simplest way to heat the feed is by the exhaust from the cylinder, either passing it into the feed-water tank, which is done in locomotives sometimes, or by forcing the feed-water through a coil of pipes surrounded by the exhaust steam. Or the feed, in its way to the boiler, is forced through a cylindrical vessel, and the exhaust steam conducted through it in small tubes, after the manner of a surface condenser. If these arrangements are provided with sufficient heating surface, the feed may be heated to 180° or 200°, but care should be taken to provide ample and unobstructed passage to the exhaust, so as not to increase the back pressure, for if the latter is only one pound per square inch higher, the loss, especially where the steam is greatly expanded, may come very near the gain by feed-heating. In a Corliss engine, working with sixty pounds pressure, cutting off at $\frac{1}{10}$th, the mean pressure is about $14\frac{1}{2}$ pounds per square inch; if the back pressure is raised one pound, the mean pressure would only be $13\frac{1}{2}$, showing a loss of

$$\left(\frac{1 \times 100}{14.5}\right) = 7 \text{ per cent.}$$

The cost of heating the feed is represented by the interest on the first cost of the heater and its cost of maintenance, and will vary somewhat according to construction, etc. On an average the *net gain* by heating the feed may be assumed as about five per cent. for condensing, and ten per cent. for non-condensing engines.—*By J. Haug, M.E., in Polytechnic Review.*

Boiling.—Boiling goods to produce lustre is a common necessity, but it is not always best to boil; a gentle steeping may serve the purpose better and prove less injurious to the material. The false

impression that the liquor is not doing the work unless greatly agitated, prevails, but not so extensively as twenty years ago. The secret of success is frequently in the rolling, the exposure, gradual cooling or in the nature and character of the fabric. When woolen goods have been excessively boiled, exposed to great heat, or cooled too suddenly, they are invariably made harsh. When the machine which rolls the goods is not powerful enough to draw the goods quite steadily, with the utmost strain necessary, look out for water marks. If the goods are not clean when boiled, clouds and dark edges may show themselves. If the colors in the goods are not fast they will sometimes be less so after boiling for lustre.

Bois Rouge.—See Camwood.

Bombazine.—(*Bombazet*, *Bombazette*, *Bombazine*, *Bombasine.*)—A sort of thin woolen cloth. Bumbazeen. *n.* [Fr., bombasin and basin; Sp., bombasi; It., bambagno; Lat., bombacinium, bombacinium, from Lat. bombycinus of silk or cotton. Bombycinum, a silk or cotton texture from Bombyt. Gr., *Bou-By* silk, cotton; It., bombazio.] A twilled fabric, of which the warp is silk and the weft worsted; formerly black, for mourning garments, but now made of various colors. [Sometimes spelled bombasin.]—*Tomlinson.*

Bombazine was first made at Norwich, England, in 1875.

Bonchon, M.—M. Bonchon, in 1725, (twenty-seven years before the birth of Jacquard,) employed *a band of pierced paper*, pressed by a hand-bar against a row of horizontal wires, so as to push forward those which happened to be opposite the blank spaces, thus bringing the loops at the lower extremity of vertical wires in connection with a comb-like rack below, etc. It will thus be seen that Jacquard was not the inventor of the first principles of the kind of looms now known the world over by his name.

Books.—The books required by the designer are few and simple; but large, must be thoroughly made, and are therefore expensive. The principal ones are design, pattern and record books. Books of instruction should perhaps be included, as no designer can now afford to refrain from much reading on subjects kindred to his calling. (*For description, see Design Books, Pattern Books, Record Books and Books of Instruction.*) The different kinds of books should be procured uniform in size if possible; this is a saving in shelf room, and adds much to the appearance of a library of this kind, great or small. Design Books should be gotten up to suit the designs to be recorded, the paper very heavy and binding first-class.

Pattern books can be got very cheap, but it is not economy to buy such; they have to be replaced too often, look bad and are generally unsatisfactory. The records are simple, and may be like the regular account books known by that name, of a size to match the others. Books of Instruction are expensive, but a necessity, acknowledged more and more every day.

Book of Ties.—To be able to apply any given pattern to the looms was formerly considered as being one of the "mysteries" of weaving, for the weaver was expected to tie up or arrange his loom to produce satins, twills, spots and small figures. He was accordingly provided with various diagrams or plans, showing him how to do so: and if he was a careful man, he would have a number of the most prevailing patterns drawn in his "Book of Ties," which was the name given to the memorandum book for that purpose. A century ago there were in this country no printed works on weaving; therefore, it may be interesting to describe a fair specimen of a weaver's pocketbook of that period, for it is questionable whether many of them remain in existence at the present time. A book of this kind is now before us; it is an ordinary long-shaped pocketbook, and contains about eighty different "ties" or patterns clearly drawn; each pattern has its particular name, such as "bird's eye or diamond handkerchief," "twelve lam diaper," "Barcelona twill," "Florentine," "Long cut velvet," "shamrock gauze," "rocktabby," "velveret," "wild-worm-warp-away," and other curious names, for weavers centuries ago were perfectly aware of the effect of a new name.—*Barlow.*

Books of Instruction.—There is no question more frequently asked by beginners than "Which is the best book for me to get?" The fact is that many are apt to expect too much of a book. In these days it is no longer possible for even the most advanced to hold his vantage ground without much reading; but he who thinks to post himself entirely from books, or he who otherwise places too much dependence upon rules and precepts which cannot be otherwise than arbitrary, must fail. A beginner should get some experienced person to pick out a plain, simple book on some particular branch to begin with; this will prepare him for more difficult work; finally standard works treating in general upon subjects kindred to his special branch will afford most profitable reading. We advise a beginner to purchase this manual first, because the price is reasonable and much aid may be derived from it; the selection of other works is also made easy. Ashton, Langewald,

Ashenhurst, Barlow, Chevreul, on colors, procured in the order mentioned, if not altogether, is money well spent. Ashton treats elementary points very satisfactorily to the beginner. Langewald supplies the largest collection of chain drafts and tables convenient in a woolen mill. Ashenhurst's work is very instructive to any one who has had a little start. Barlow is very interesting and important to those who wish general knowledge of weaving and its history.

Borate of Soda.—*Borax.*

Borax.—Biborate of soda; a salt formed by a combination of boracic acid with soda. It was originally obtained from a lake in Thibet, and was sent to Europe under the name of *tincal.* It is of a white color or sometimes grayish, or with a shade of blue or green.

Bord or Burda.—A striped cloth. Burd Alisaunder, the oldest known design for any textile fabric.

Bow.—A device on the point of a shuttle to separate the shed. Used when the warp threads are inclined to stick together. It is usually made of horse hair or very fine wire.

Bowed Gorgia Cotton.—"Bowed Gorgia" takes its name from a mode of cleaning which has long been in disuse. This operation was performed by means of a bow-string, which being raised by the hand, and suddenly released, struck upon the cotton with considerable force, and thereby served both to separate the gins and to open the cotton, rendering it more fit for the processes which followed. "It has long since been abandoned for other and more rapid methods of cleaning."—(Baird.) What is now called "Bowed Gorgia" has been cleaned by a machine called a saw-gin.

Boxes.—Shuttle boxes on looms are often troublesome, because supported by a crooked spindle. The position in relation to the race board, when the shuttle is to pass in or out, is of great importance, and varies on looms of different construction sometimes to the extent of $\frac{1}{8}$ inch. Some weavers claim that a box should never be level, but aim downwards a little; the advantages claimed for this mode of setting are that it keeps the shuttle from flying out, and catches the shuttle gradually on its coming in. This theory is not accepted by others who are equally successful. Timing the motion of the boxes is a nice point, but carelessly done by a large proportion of loom fixers. The cleanliness of boxes should be scrupulously attended to.

Box Motion.—The mechanism on looms for raising and lowering

the shuttle boxes is an important part of the whole. This has led to many inventions, some good, others almost worthless, and many which conflict with each other in claims of inventors. The very motion that we would recommend is in controversy.

Bow Cords.—The term used to designate the cords between the raising lever or couper, and the harness or leaf of certain kinds of hand looms.

Brazil Woods.—There are several varieties of this wood, which are distinguished from each other by the name of the place where they are obtained—Pernambuco, Japan, Hypernic wood, Nicaragua, etc., and they all give a handsome red; and in relation to dyeing, may be considered as only different names for dyestuffs producing similar coloring effect, and only differing in some little particulars. In the dyehouse they are often all called peachwood. The wood known in commerce as Pernambuco is most esteemed, and has the greatest quantity of coloring matter. The kind termed Hypernic or Lima wood is the same in quality. A decoction of Lima wood presents a rich crimson color, which acids and acidulous salts will change to orange, and alkalies turn to purple. The salts of potash, soda and ammonia change the solution into a rose color, which soon passes away by standing. Solutions of tin throw down a bright red colored lake, and alum precipitates slowly a bright and clear red. Nicaragua or peachwood (sometimes called Santa Matha wood) is much used in the dyehouse, and for many shades of red is preferred, although the coloring matter is not so great. It gives a bright dye. It is better adapted to coloring reds than Lima wood, and this latter is better for garnets, rubies, maroons, etc., on account of its deep crimson-colored solution. But all the colors obtained from any of these woods are of a fugitive nature, losing their brilliancy by exposure to the air. The sun has a very powerful influence upon colors dyed by these woods. By a short exposure the red color assumes a blackish tint, passes into a brown, and fades away into a light dun color. The best preparations for reds from these woods is alum and tartar—the tartar about one-eighth the weight of alum. The best temperature to commence dyeing these colors is about 180°, and bring up to a boil as soon as possible, and boil no longer than to get the shade required.

Brushes.—The brushes needed by a designer are two in number—one of the best bristle clothes brushes for brushing samples, not too large or stiff, not too limber; also, a small brush for clearing the projecting threads when dissecting. Factory brushes are

more numerous in kinds, for brushing cloth, gigg slats, warps, etc., etc.; also for dabbing the stock into the circles on combs and other like work. The very best brush bristles are cheapest.

BROCADE.—A cloth with figures woven with gold or silver threads.

BRUSH WHEELS.—In light machinery, wheels are sometimes made to turn each other by means of bristles fixed in their circumference; these are called brush wheels. The term is sometimes applied to wheels which move by their friction only.—(Ure's Dictionary.)

BUNGOES.—A peculiar kind of shawls first made at Strathbungo near Glasgow, Scotland. Sometimes applied to other fabrics supposed to resemble the texture and character of these shawls.

BRUSSELS CARPET.—Brussels and other pile carpets are made upon the same principle as velvet, but generally the pile is not cut, consequently round wires are used instead of grooved ones, and they are drawn out from the sides of the cloth. There are two descriptions of Brussels, one in which the pile threads have the pattern printed upon them previous to weaving, and the other in which the threads are used dyed in separate colors. The first kind is known as tapestry carpets, patented in 1832, by Mr. Whytock of Edinburgh, and forms a comparatively simple and cheap manufacture when compared to Brussels carpets.

BUCKRAM.—A coarse linen cloth stiffened with glue, named from buco, a hole, or from Bokkara.

BUREL.—A coarse stuff used during the thirteenth century.

C.

CALCIUM.—The metallic base of lime.

CALCULATIONS.—Mathematical calculations are numerous in and about the factory. Those which fall to the designers' lot frequently include estimates of cost, as well as quantity of yarn and stock needed for separate orders. Many of the more important calculations are treated in other parts for the sake of clear connections. To be methodical in all things should be the aim of all, designers in particular; it is a useful as well as commendable virtue. To give the necessary methods for all factory calculations would require a large volume, and the best would be incomplete. The better way is to supply, in the proper places, elementary rules, and urge every

one to reduce all their calculations to a systematic method; to decide on some good way to proceed for the various kinds of mathematical problems which come up frequently, and make use of such method until it can be abandoned for a better one in earnest; never employ too many ways to solve the same kind of problems. It is well to know several ways, as they may be used for proving work, but an unmethodical use of such knowledge is demoralizing. Most of the examples given in this work will be found with the rules. The impossibility to collect even in small districts of England statements of any number which agree, on the subject of mathematical terms and methods in textile calculations, on account of the great diversity of methods employed, verifies the preceding remarks. (See Barlow and Ashenhurst.) The latter is quoted as good authority, and to show how utterly impossible it is to create order out of the chaos existing in some districts, the quotation is in another part in connection with "Yarn Counts or Numbers."

Calico Printing is the art of producing a pattern on cotton cloth by printing in colors, or mordants, which become colors when subsequently dyed. Calico derives its name from Calicut, a town in India formerly celebrated for its manufactures of cotton cloth, and where calico was also printed. Other fabrics than cotton are now printed by similar means, viz., linen, silk, wool and mixtures of wool and cotton. Linen was formerly the principal fabric printed, but since modern improvements have produced cotton cloth at a comparatively cheap rate linen fabrics are now sparingly used for printing, and then principally for handkerchiefs, linen cloth not producing such beautiful colors, in consequence of the small affinity of flax for mordants or coloring matters. Silk printing also is chiefly confined to handkerchiefs, but the printing of woolen fabrics or mousseline delaines is an important branch of the art. (Ure's Dictionary.)

Cambric.—A cotton cloth. No doubt the name is derived from Cambray.

Callenders.—Callenders are machines with two or more cylinders, now generally heated by steam, used in some of the finishing processes; also by the calico printers to prepare the surface of the goods. The complete and perfect callender is a large and expensive machine, and may be much modified for certain fabrics. It is always best, however, to have one so fitted that it may be worked with any degree of pressure between the rolls, from that which simply insures regular contact to that which will produce a glaze on

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almost any fabric. A very good use for callenders, but by no means common, is that made of it by a few manufacturers of worsted goods of the heavier classes. After pressing it is necessary to take off the glaze with steam; if the goods are immediately dried on a callender after this steaming, all firmness given the goods by pressing remains; if not, the moisture gradually penetrates the goods and an undesirable result is the consequence.

Camwood.—This is another species of the red woods, and grows in Sierra Leone and those countries adjacent to the Bight of Benin. Its chemical properties and nature are very similar to barwood and sanders, being called by botanists *bois range*. It contains more coloring principle, and the color is more permanent than sanders or barwood. It comes to the dyer in a ground state, same as barwood and sanders. The precipitates from a solution of this wood are of a more yellow cast, which explains why the colors dyed by it are so much more intense and rich than colors from the other red woods, its color being more of a decided red. It is more extensively used in woolen dyeing than either of the other red woods, for the reasons given above. It will give a permanent color either with or without a mordant. Camwood gives out its color with great reluctance, but by taking the plan laid down for barwood and adding to the color-bath one-half ounce of soda-ash (Na_2CO_3) for every twelve pounds of camwood used, just as the wool is to be entered for coloring, will make a great difference in the quantity of color obtained, and the wool will not feel so harsh, but will work more open than if the soda-ash had not been used. Camwood naturally gives a harsh feeling to wool, but not so much so as sanders. Reagents give the following results: Sulphate of iron ($FeSO_4$) gives a plum color; muriate of tin ($ShCl_2$) gives a bright carmine-red color; sulphate of copper ($CuSO_4$) gives a handsome looking claret; alum (AlSO) gives the solution a beautiful red color; acetate of copper ($IC_4O_3H_32Cu$) gives a light reddish brown; nitrate of iron ($3No_62Fe$) gives a reddish brown. None of the salts of lime seem to produce desirable results upon it as a mordant. The sulphate of copper (blue vitriol) gives the best results, or effects, upon the color of this wood, and appears to be the most effectual mordant for it, especially if using it for browns.—*Gibson.* A light bath of camwood before dyeing prevents wool from felting somewhat.

Cards.—This term has many meanings in the textile world. We card cotton and wool with cards. The patterns on Jacquards and

some other looms are produced by the pattern cards. We have pattern cards for another purpose also; upon these we paste samples of goods. Railroad cards are simply from six to twelve cotton cards connected by what are termed railroads; these are a trough in which a strap carries the slivers from all the cards to a series of rollers; the slivers are delivered into a can, after passing through the rollers. These devices for saving labor are of great value as they make better work by more doubling.

CARDING.—The carding of stock is very important. What can be learned from books should be studiously sought; but experience is indispensable to any one who is to have charge of the process. There are many good books to be had, and, unlike works on weaving, most of them are sold at very low prices. Leroux's remarks on this subject are very valuable. Baird in his work on cotton manufacture says: "Cards are used to disentangle the fibres of cotton, and lay them lengthwise and parallel with each other. Carding consists in the reversed action of two opposite surfaces, which are studded with angled wire hooks. These hooks must be made of good, hard-drawn iron wire, to render them stiff and elastic. In former years, cards were merely made of small straight boards, studded with sharp wire points, and having handles; these were operated by hand: now, they are encased cylinders, driven by steam or water power. These machines consist of one large, and often of many small cylinders. If the large cylinder is partially surrounded by small cylinders, the card is intended for coarse yarn, or coarse wool or cotton; if it contains but one or two small cylinders, it is used for fine cotton and fine yarn. This machine receives the coil of lap from the spreading-machine, which is as wide as the card, and forms it into a lamina, in which the fibres of cotton are more or less parallel, according to the work. Coarse yarn requires the cotton to be carded but once; but, for fine yarn, it is necessary to repeat the operation."

CARPETS.—Carpets are no longer a luxury enjoyed by the wealthy alone, their use has become so general that many kinds are now needed to meet the varied demands. These kinds or classes are so commonly known by their names that it is quite needless to enumerate them. It would be quite as unsatisfactory to consider each as briefly as space here would require. The fact is, an exhaustive work on the manufacture of carpets is greatly needed, so much so that anything short of it will not be acceptable. The subject is

pretty extensively treated by Barlow, and many illustrations make this part of the work quite instructive to those who are making the methods of producing textile fabrics a general study. Ashenhurst is also thorough in the chapters devoted to carpets, but has not made use of illustrations so profusely as Barlow.

Cashmere or Cachemere.—The genuine fabrics of this class, at one time the only goods sold under this name, were formerly produced in the Kingdom of Cashmere. They are now made to greater perfection in Europe. The material of the cashmere shawls is the downy wool found on parts of the Thibet goat (only a small percentage of their coats by weight). The Oriental Cashmere shawls are the results of extremely slow weaving processes. The Jacquard loom produces better goods at much less cost.

Cassimeres or Kersimeres.—Almost any woolen cloth that has not for some special reason another name is conveniently classed among cassimeres by the trade. Really this class of goods includes only plain and fancy cassimeres, both being woolen goods that have been milled—the difference between the plain and fancy being in the appearance. Plain cassimeres may be made of any texture which will look smooth and plain on the face; even twills are classed in this line, when not too large; diagonals can not be. This class must also be of one color or mixture only. When more than one color, large or fancy diagonals, or otherwise fancy effects or textures are used, the goods are properly fancy cassimeres. "Cotton warp fancy cassimeres" is a trade name to pass off fancy effects of a cheaper grade (made as the name implies in part of cotton), for which there is no more appropriate name in common use. Some "Union cassimeres" are of this order.

Catechu.—"This is another substance containing a great deal of tannin or astringent principle. It is a dry extract, prepared from the wood of a sensitive plant called *Terra Japonica*. It grows in the mountainous districts of Hindostan. Catechu is dark brown or chocolate color, with an astringent taste, but no odor or smell. It contains about 50 per cent. of tannin principle; gum, 8; extractive matter, 35; impurities, 7 := 100.

Proto-sulphate of Iron gives olive brown precipitates.

Chloride of Tin and Bi-sulphate of Copper gives yellowish brown precipitates.

Bichromate of Potash gives a deep, rich, red brown precipitate.

There are different qualities as well as kinds of catechu in the market. The Bombay comes to us in square masses, of a reddish

brown color. Its composition is: Tannin, 50; extractive matter, 35; gum, 8; impurities, 7 := 100.

The Bengal catechu is found in market in flattish round lumps. The outside color is a light brown; the inside, dark brown. Its composition is: Tannin, 48.9; extractive matter, 37.0; gum, 7.5; impurities, 6.6 := 100.

The Malabar catechu we receive in large masses. The color is of a light brown outside, but dark colored inside, and covered with leaves. Its composition is: Tannin, 45.3; extractive matter, 39.5; gum, 8.5; impurities, 6.7 := 100.

Catechu is adulterated with sand, clay and ochre. The adulteration can be easily detected by dissolving some of it in water, and these impurities will settle, as good catechu is all soluble in water, and gives a clear solution, of a beautiful reddish brown color, which acids will brighten and alkalies darken, and the shade deepen by standing. The tannin that is contained in catechu is not so easily converted by exposure into gallic acid as nutgalls are, but is subject to oxidation. When catechu is oxidized, there is a formation of an acid nearly like that of gallic acid; but this acid is only formed when a solution of catechu is treated with an alkaline matter. Catechu is now used in almost all the compound colors on raw cotton and cotton yarns—blacks, browns, drabs, fawns and greens; and its permanency causes it to be of such high estimation in the coloring of raw cotton at the present time."—*Gibson.*

Chenille Weft.—To produce an imitation of pile or velvet goods chenille weft or filling serves well. It is made by weaving a fabric that may be cut into narrow strips, the raw edges of which when twisted afford the projecting fibers. To make the strips fine or narrow it is necessary to cross-weave them; this binds the short pieces of threads more firmly. Elegant shawls, cloakings, carpets and robes are made with this filling. There are looms built especially for weaving many kinds of chenille weft.

Chloride of Calcium.—Lime and muriatic acid.

Chinchilla.—These goods are used for cloaks and sometimes for overcoatings. It may be presumed that some fabric of this class at one time had some resemblance to the fur of an animal by this name, but few of the goods now sold under it can be said to retain the resemblance. Chinchilla goods must be of stock and texture to permit a long full nap. The disposal of the nap varies. Some kinds are curled, others are made wavy, yet others straight, etc., etc. The whipping machine is a necessity in the finishing of these goods.

CIRCLES.— *Circular Swivels or Lappets and Circular Shuttle Boxes* are subjects described by Barlow and many other writers on looms and weaving. To write understandingly about them requires the use of illustrations and considerable space. Comb circles are more easily described. They consist of a brass or composition base, in circular form to fit the combing machines, from $\frac{1}{4}$ inch to $\frac{3}{4}$ inch in thickness, according to the work they are intended for. Through this base pins are driven in rows, the size of the pins, shape and their number also depends on the kind of work. The pins should not be too soft or too hard, as hooked points or broken pins make bad work. Neither should the pins be set any closer together than is absolutely necessary to clear the wool. When close set, the stock must be fed very light or the dabbing brush will not be sufficient to force it between the pins.

CLOTH.—The word cloth is frequently used instead of fabric, erroneously. Almost any textile fabric may be cloth, but the more common use of the word is for heavier goods, and particularly those made of wool, like broadcloth, beavers, etc., etc.

CLOTH FINISH is a term used to designate that finish on woolens similar to broadcloth.

COCHINEAL.—" This is a small insect, called *coccus cacti.* It is a native of those parts of South America bordering on the Gulf of Mexico, of St. Domingo, Cuba and several other of the West India Islands, in which places it is sometimes found wild." It produces the finest known shades of crimson, red, scarlet, etc., for woolen or silk. Some cultivators use steam for killing the insect, and the different appearances of the cochineal are caused by the different modes of killing the insect. The best sorts are those that appear as if dusted with white powder, and are of a slate color; but this appearance is not a sure criterion to go by, as the dealers very often dust the cochineal with powdered talc, to deceive the purchaser. There are two kinds of cochineal, the silver and the black cochineal. The latter, as a general rule, is inferred to be the most valuable, but this is a nice distinction, and only holds good when the two kinds present the same specific resemblance, for a bold, clear silver is preferable to a black of opposite appearance. In making choice of cochineal, you must observe that each grain exhibits a bright, free, clear, bold and large appearance; whether the whole mass be free from dust or small abraded parts of the insect, or matters

foreign to its nature; and whether a quantity of it has a certain weight or specific gravity, which any person much accustomed to testing weights can distinguish with the greatest nicety. Cochineal is the richest in coloring principle of all the known dyestuffs, having 50 per cent. of pure crystalizable coloring principle; its clear and filtered solution, with the different mordants or mineral salts, etc., also in solution, present the following results:

Tannin does not throw down any precipitate.

Boracic acid does not change the color, but rather reddens it more.

Nitrate and nitro-muriate of per-oxide of iron precipitates a chocolate colored lake, the nitro-muriate the brightest.

Bi-sulphate of copper, a red purple deposit, a portion of the color remains in solution.

Potash, Soda and Ammonia change it to a crimson violet.

Protoxides of Tin produce the same effect.

Per-oxide of Tin changes it to a yellowish red.

Chlorine turns it yellow.

Sulphate of magnesia, no precipitate, the solution unaffected.

Lime gives scanty precipitates of a violet or deep lilac color.

Oxalic acid turns the solution orange color.

Citric acid similar effects, but of a redder hue.

Super-tartrate of potash brightens up the solution, causing it to assume a fine scarlet color, and a slight precipitate falls of a red color.

Super-oxalate of potash produces more decided effects of the same character as the preceding.

Alum gives the liquor a fine crimson appearance and a moderate precipitate of the same color takes place, the liquor still retaining considerable coloring matter, which a solution of nitro-muriate of tin precipitates of a more decided scarlet, leaving the liquor of a pale fawn color."—*Gibson.*

Color.—In many fabrics the colors are quite as important as the texture, consequently it behooves the designer to acquire a thorough knowledge of the laws which govern their harmony. This can be done only when the nature of colors is thoroughly comprehended. The whole combined is a science of which Ashenhurst says: "The science of color teaches the nature and causes of colors, their distinctions, their relations to each other, their classification, the mental effects that attend them, and the causes and laws of harmony. It also includes the modifications of colors arising

from varying sensibility of the eye, and the peculiarities of color vision which are found to exist in different individuals." So important is the science that it would be folly to undertake a brief lucidation of it, consequently the reader is referred to "Chevreul on Color," a work of the highest merit, and one which cannot fail to interest any one who has the real requisites of a designer. The harmony of colors, the influence of one color over another when placed in close proximity to each other, are subjects which can only be really understood after much preparatory study. For any one who cannot at once interest himself in so thorough a work as Chevreul's we recommend the concluding chapter of Ashenhurst's work on "Weaving and Designing"—a brief and lucid description of the science of color and very important suggestions as to their application in textile fabrics. The following remarks from Christopher Dresser, may aid some beginners who have other necessary expenses to meet at present and must defer the purchase of the books mentioned: "There are few objects to which color may not be applied, and many articles which are now colorless might be colored with advantage. Our reasons for applying color to objects are twofold, and here, in fact, we see its true use. First, Color lends to objects a new charm—a charm which they would not possess if without it; and, second, Color assists in the separation of objects and parts of objects, and thus gives assistance to form. These, then, are the two objects of color. Mark, first, it is to bestow on objects a charm, such as they could not have in its absence. In the hands of the man of knowledge it will do so—it will make an object lovely or lovable, but the mere application of color will not do this. Color may be so applied to objects as to render them infinitely more ugly than they were without it. Knowledge will enable us to transmute base materials into works of marvelous beauty, worth their weight in gold. Knowledge, then, is the true philosopher's stone; for, we may almost say, if possessed by the artist, it does enable him to transmute the baser metals into gold. But a little knowledge will not do this. In order that we produce true beauty, we require much knowledge, and this can only be got by constant and diligent labor, as I have before said; but the end to be gained is worth the plodding toil. The second object of color is that of assisting in the separation of form. If objects are placed near to one another, and these objects are all of the same color, the beholder will have much more difficulty in seeing the boundaries or terminations of each than he would were they variously colored; he would have to come nearer to them in order to

see the limits of each, were all colored in the same manner, than he would were they variously colored : thus color assists in the separation of form. This quality which color has of separating forms is often lost sight of, and much confusion thereby results. Color is the means by which we render form apparent. Colors, when placed together, can only please and satisfy the educated when combined harmoniously, or according to the laws of harmony. What, then, are the laws which govern the arrangement of colors ? and how are they to be applied ? We shall endeavor to answer these questions by making a series of statements in axiomatic form, and then we shall enlarge upon these propositions.

General Considerations.—1. Regarded from an art point of view, there are but three colors—*i. e.*, blue, red and yellow.

2. Blue, red and yellow have been termed *primary* colors ; they cannot be formed by the admixture of any other colors.

3. All colors, other than blue, red and yellow result from the admixture of the primary colors.

4. By the admixture of blue and red, purple is formed ; by the admixture of red and yellow, orange is formed ; and by the admixture of yellow and blue, green is formed.

5. Colors resulting from the admixture of two primary colors are termed *secondary* : hence purple, orange and green are secondary colors.

6. By the admixture of two secondary colors a *tertiary* color is formed : thus, purple and orange produce russet (the red tertiary) ; orange and green produce citrine (the yellow tertiary) ; and green and purple, olive (the blue tertiary) ; russet, citrine and olive are the three tertiary colors.

Contrast—7. When a light color is juxtaposed to a dark color, the light color appears lighter than it is and the dark color darker.

8. When colors are juxtaposed they become influenced as to their hue. Thus, when red and green are placed side by side, the red appears redder than it actually is, and the green greener ; and when blue and black are juxtaposed, the blue manifests but little alteration, while the black assumes an orange tint or becomes " rusty."

9. No one color can be viewed by the eye without another being created. Thus, if red is viewed, the eye creates for itself green, and this green is cast upon whatever is near. If it views green, red is in like manner created and cast upon adjacent objects ; thus, if red and green are juxtaposed, each creates the other in the eye, and the

red created by the green is cast upon the red, and the green created by the red is cast upon the green; and the red and the green becomes improved by being juxtaposed. The eye also demands the presence of the three primary colors, either in their purity or in combination; and if these are not present, whatever is deficient will be created in the eye, and this induced color will be cast upon whatever is near. Thus, when we view blue, orange—which is a mixture of red and yellow—is created in the eye, and this color is cast upon whatever is near; if black is in juxtaposition with the blue, this orange is cast upon it, and gives to it an orange tint, thus causing it to look "rusty."

10. In like manner, if we look upon red, green is formed in the eye, and is cast upon adjacent colors; or, if we look upon yellow, purple is formed.

Harmony.—11. Harmony results from an agreeable contrast.

12. Colors which perfectly harmonize improve one another to the utmost.

13. In order to perfect harmony, the three colors are necessary, either in their purity or in combination.

14. Red and green combine to yield a harmony. Red is a primary color, and green, which is a secondary color, consists of blue and yellow—the other two primary colors. Blue and orange also produce a harmony, and yellow and purple, for in each case the three primary colors are present.

15. It has been found that the primary colors in perfect purity produce exact harmonies in the proportions of eight parts of blue, five of red and three of yellow; that the secondary colors harmonize in the proportions of thirteen of purple, eleven of green and eight of orange; and that the tertiary colors harmonize in the proportions of olive twenty-four, russet twenty-one, and citrine nineteen.

16. There are, however, subtleties of harmony which it is difficult to understand.

17. The rarest harmonies frequently lie close on the verge of discord.

18. Harmony of color is, in many respects, analogous to harmony of musical sounds.

Qualities of Colors.—19. Blue is a cold color, and appears to recede from the eye.

20. Red is a warm color, and is exciting; it remains stationary as to distance.

21. Yellow is the color most nearly allied to light; it appears to advance toward the spectator.

22. At twilight blue appears much lighter than it is, red much darker, and yellow slightly darker. By ordinary gaslight blue becomes darker, red brighter, and yellow lighter. By this artificial light a pure yellow appears lighter than white itself, when viewed in contrast with certain other colors.

23. By certain combinations color may make glad or depress, convey the idea of purity, richness or poverty, or may affect the mind in any desired manner, as does music.

Teachings of Experience.—24. When a color is placed on a gold ground, it should be outlined with a darker shade of its own color.

25. When a gold ornament falls on a colored ground, it should be outlined with black.

26. When an ornament falls on a ground which is in direct harmony with it, it must be outlined with a lighter tint of its own color. Thus, when a red ornament falls on a green ground, the ornament must be outlined with a lighter red.

27. When the ornament and the ground are in two tints of the same color, if the ornament is darker than the ground, it will require outlining with a still darker tint of the same color; but if lighter than the ground, no outline will be required."

The surest and readiest method of acquiring a practical knowledge of colors and their effects in textile fabrics, is to analyze a large collection of samples. Fashion controls the designer to a great extent; and fashion moves in cycles. Exhaustive collections of the most fashionable colors and combinations of each season, with a proper record of particulars, will not only add to one's stock of knowledge, but any one who is at all observant will, after a while, be enabled to prognosticate coming demands of fashions, with considerable accuracy. The value of this ability needs no comments, every designer has suffered more or less from a lack of it, both in himself and in those who assume the control of the patterns in the market.

Combing and Combing Machinery.—Combing is an old branch of textile manufactures, but the perfection of the machinery employed is the result of many inventions within the last fifty years. Camel hair, cotton, flax, silk and wool are extensively combed. The best work on wool combing, etc., is Leroux's

"Manufacture of Worsted and Carded Yarns." The works on these subjects are still very few, in the English language.

Combs or Comber Boards are the parts of Jacquards through which the leashes pass, and by which they are kept in regular order and separate.

Cords.—This term, when used to designate certain effects in fabrics, is erroneously applied in many cases. Ribs of various kinds running either lengthwise or crosswise are given this appellation by different designers, but the best authorities seem to agree that the only effect that can properly be called a cord is a rib lengthwise of the goods, evenly and entirely covered by regular floats of the filling. That there may be variations no one will deny, but reps should not be called cords nor cords reps.

Cotton.—Cotton is a fibrous down, which invests the seeds of a peculiar plant, called gossypium by Linnæus. It has a cup-shaped calix, with five obtuse teeth, enclosed in an exterior calix having three clefts. Botanists describe thirteen species of this plant, which furnish the very dissimilar staples found in commerce. The length, flexibility, tenacity and thickness of the fibres of the different descriptions of cotton form the basis for estimating the value of the article. When examined through a good microscope, the fibres of cotton are seen to be more or less flat and twisted, and to have a breadth varying from $\frac{1}{800}$ of an inch in the Smyrna, or candle-wick cotton, to $\frac{1}{2500}$ of an inch in the finest Sea Island. The fineness of the cotton, where No. 500 is spun, is apparent from the following circumstance. It is said that a house in Manchester, England, is preparing a fabric for the Great Industrial Exhibition of London, which is to be spun from a pound of cotton, and to extend in length 238 miles and 1120 yards. There are in the warp eighty layers of a yard and a half each, with seven warps to the hank and 500 hanks in the pound of cotton. This is a thread which is finer than the finest silk, and cannot contain more than three or four fibres of the finest Sea Island cotton. The main distinction between the various kinds of cotton in the pod is the black seeded and the green seeded. The first separate from the fibre very easily, while the latter adhere to it with great tenacity and require the aid of the gin to separate them from it. After the cotton is separated from the seed, it is packed in strong presses and formed into bales of from 200 to 500 pounds each. Bales of American cotton generally weigh about 500 pounds each.—*Baird.* (See *Baird's Cotton Spinner* for description of different kinds.)

Crape Silk.—Barlow says "the process of making it (crape silk) consists in extra spinning, sizing and stoving, and not in any peculiarity in weaving." Imitations are made to appear like real silk crape in the finishing processes, such as running the fabric through heavy size and crimping machinery.

Cross Drawing.—The definition of this term is already given in an allusion to it under the head Draw. The beginner is always impatient to master this mysterious part of designing. Mysterious: first, because some men foolishly think they add to their own importance if they can be mysterious about their labors. Second, because many are very unsystematic about the arrangement of their drafts, or even worse, do their work without thoroughly understanding the principles. However this may be, the secret of success is not so much in great skill as in perseverance and practicability. Neither is there any serious complexity about it, as one would think from the awe it has inspired. The principle is one and simple. Whenever the drawing in hand comes to a thread which is to work the same as a previous one, it must be drawn in on the same harnesses. That is: threads which work exactly alike may be governed by one and the same harness. To reduce a *full draft* to working drafts, is the most confusing part of the work. It is not always best to follow to the letter the above cited principle, and yet it is desirable to use as few harnesses as possible. The few examples selected for illustrations involve the principles completely, and are so simple as to be easily understood. The alphabetical order of headings brings them into the first part of the book, while simple textures are illustrated further on. The latter should be well understood before going on with these. (See Textures.) No. 37 is a texture that can be woven on any loom that will produce a 4 leaf twill, simply by drawing in the threads on 4 harnesses in the order specified by the drawing-in draft. We will suppose that the full draft has been obtained by dissecting a sample. Begin at the left hand, examine every column of squares (columns represent warp threads, lines filling). The first is to be marked No. 1, the second works differently, it cannot therefore be drawn on the same harness as the first thread, consequently we assign to it the second harness and mark it 2. The third thread is marked 3 for the same reason, and the fourth, 4. But the fifth thread is like the first again, therefore, it may be drawn on the same harness as the first thread—and is marked 1; the sixth thread is marked 2; the seventh 3; the eighth 4, for the same reason. The ninth thread is like the second;

consequently marked 2; the tenth like the first and marked 1; the eleventh, 4; and the twelfth, 3; and so on the end, the entire fabric being a repetition of the first 4 threads, but in different order. After marking each thread below as per upper line of numbers by the above method, we have only to write these numbers in the form most convenient for the drawing in hand, for really this line of numbers is the drawing-in draft. We have found that only 4 harnesses are necessary for this texture; therefore, we confine the drawing in draft to 4 columns of squares, and copy the line of numbers into these columns, always putting the figures, in the respective column. The form employed here puts only one figure on a line, this avoids all confusion, but it takes a little more paper than putting such figures as come in consecutive order on the same line each time. Again, some designers instead of writing the figures in the Drawing-in draft, use only a mark, this answers the purpose when understood. The Drawing-in draft having been deduced, the chain draft is next in order. Copy the first column from the full draft in another place on the paper, find the second by the row of numbers below, copy it next to the first, the same with the third and fourth. The result is the chain draft, a plain 4-harness twill, which, by the way, could be seen complete and intact on the first 4 threads of the full draft. By examining the other examples it will be noticed that this is not always the case; the representative harnesses being less regular in their order of occurrence in some of them. Let us suppose that we have a fancy loom to weave this fabric on; that we may employ eight harnesses, which is desirable when there are many threads in the warp. Let the student give the full draft a little thought; he will see that it has eight threads with the twill to the right, eight with the twill to the left, eight with a broken twill; eight with twill to the right again, eight with twill to the left again, and eight with a basket texture. We will, therefore, divide it evenly and produce a systematic draft by taking four harnesses for the right hand twill, four more for the left hand twill, and divide the threads of the broken twill and the basket texture among these two sets. The second row of figures below the draft is the manner in which the work can thus be divided among eight harnesses. The student should see if these figures have been put down correctly, and draw off the working drafts; then compare with the one (B) given; in this way practice is at once applied. No. 40 can be woven on four harnesses, as is shown by the working drafts (B) deduced; but some designers recommend five harnesses, thinking that the harnesses

work better in the loom. [See Drafts "A."] But if any harnesses are to be added, it would seem that "C" would be far better. They all produce the same thing. The student should reduce the full draft to each of them, and thereby learn that cross draws are only limited by the number of harnesses employed; that in reality they are made use of for the purpose of producing the full draft with less harnesses than it would require were one harness given to each thread of the texture or pattern, regardless of the many which would work alike, and could therefore be spared. On the jacquard there is no cross-drawing, as the threads of a texture or pattern are all provided for by an independent mail and corresponding cord. Nos. 38 and 39 are given for practice of the beginners; they involve the same principles, but, being larger, look a little more difficult.

NO. 37.

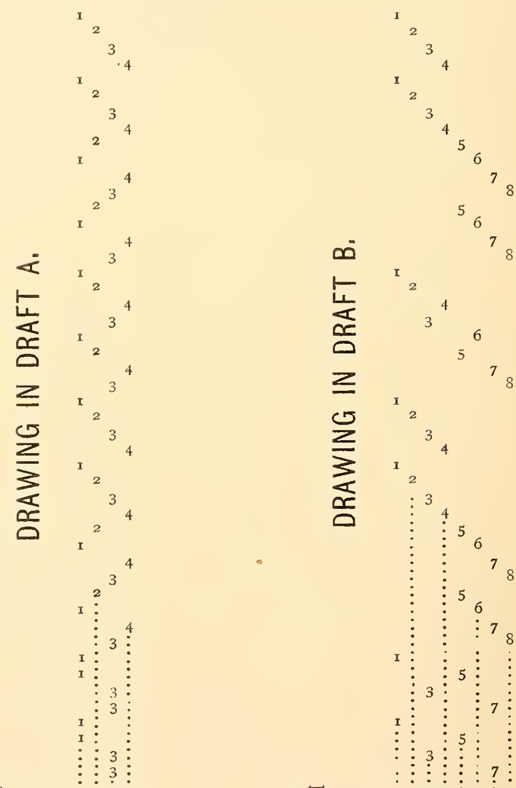
FULL DRAFT OF TEXTURE.

□□□□**□□**□□**□□**□□**□□**□□**□□**□□**□□**□□
*□□**□□*□**□□**□*□*□*□*□*□□**□□*□**□□**□**□□**□□
□□**□□**□□**□□**□□**□□**□□**□□**□□**□□**□□**□□**
□**□□**□*□□**□□*□*□*□*□*□**□□**□*□□**□□*□□**□□**

1 2 3 4 1 2 3 4 2 1 4 3 2 1 4 3 1 2 4 3 1 2 4 3 1 2 3 4 1 2 3 4 2 1 4 3 2 1 4 3 1 1 3 3 1 1 3 3
Drawing in Draft A.

1 2 3 4 1 2 3 4 5 6 7 8 5 6 7 8 1 2 4 3 6 5 7 8 1 2 3 4 1 2 3 4 5 6 7 8 5 6 7 8 1 5 3 7 1 5 3 7
Drawing in Draft B.

REDUCED DRAFTS.



Chain Draft A.

4**□□
3*□□*
2□□**
1□**□
1 2 3 4

Chain Draft B.

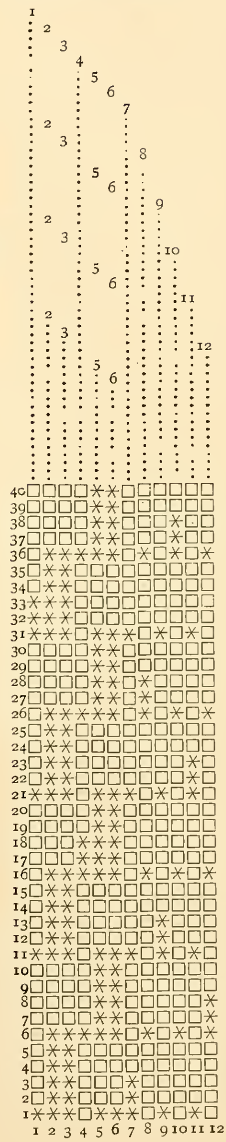
4**□□**□□
3*□□*□**□
2□□**□□**
1□**□*□□*
1 2 3 4 5 6 7 8

NO. 38.

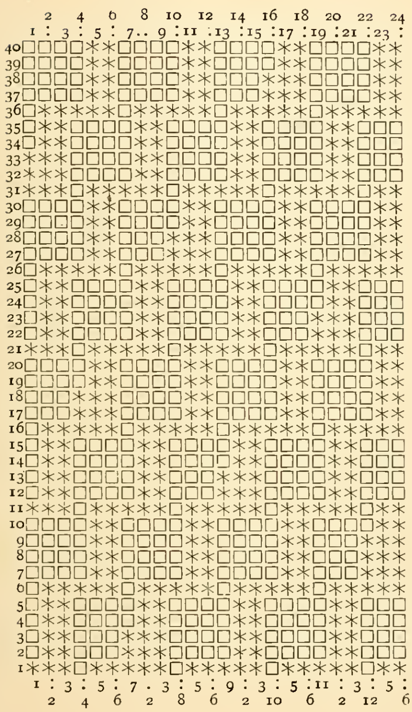
REDUCED DRAFT.

DRAWING IN DRAFT.

CHAIN DRAFT.

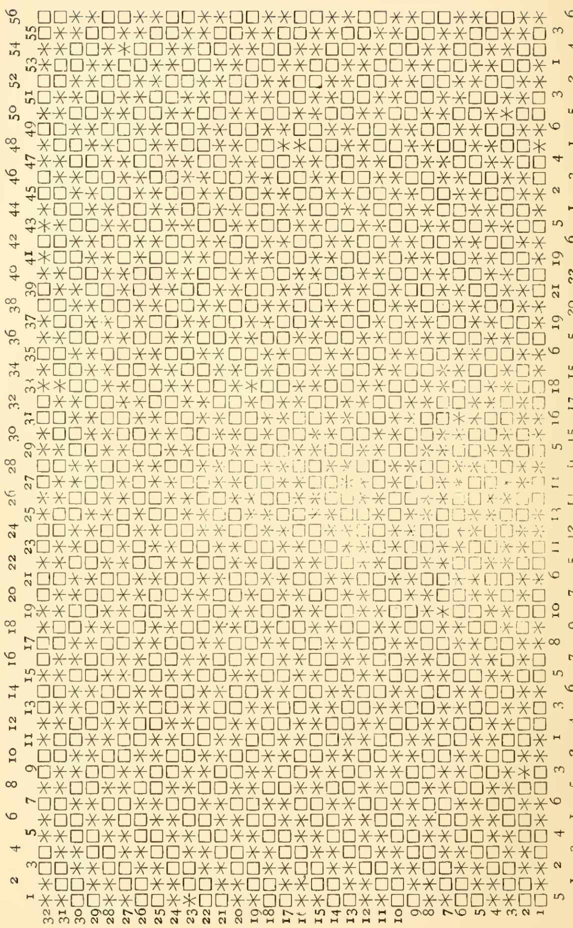


FULL DRAFT OF TEXTURE.



NO. 39.

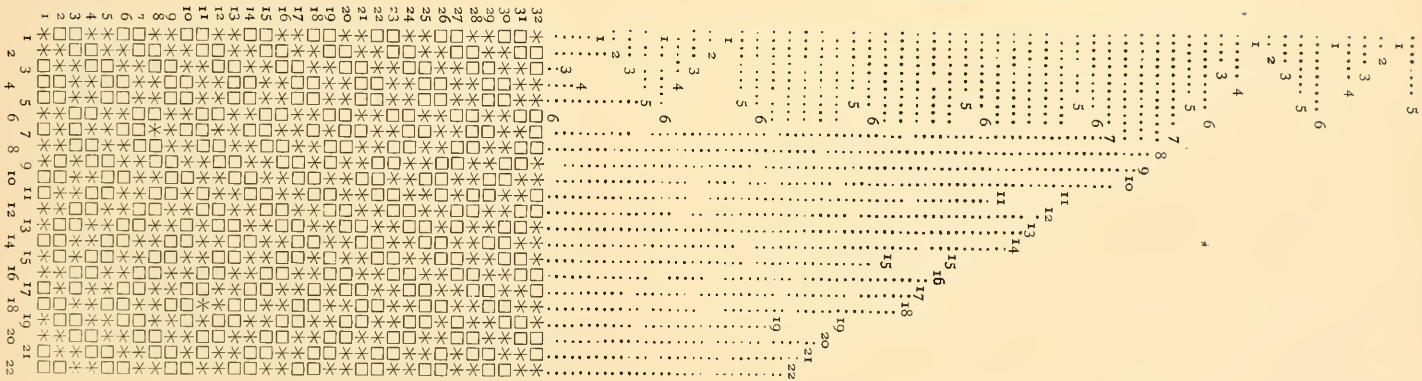
FULL DRAFT OF TEXTURE.



NO. 39.—REDUCED DRAFT.

CHAIN DRAFT.

DRAWING IN DRAFT.



NO. 40.

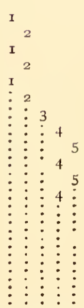
FULL DRAFT OF TEXTURE.

	1	2	3	4	5	6	7	8	9	10	11	12	
12	*	*	*	*	*	*	□	*	□	*	□	*	
11	□	□	□	□	□	□	□	*	□	*	□	*	
10	*	*	*	*	*	*	□	*	□	*	□	*	
9	□	□	□	□	□	□	□	*	□	*	□	*	
8	*	*	*	*	*	*	□	*	□	*	□	*	
7	□	□	□	□	□	□	□	*	□	*	□	*	
6	□	*	□	*	□	*	*	*	*	*	*	*	
5	□	*	□	*	□	*	□	□	□	□	□	□	
4	□	*	□	*	□	*	*	*	*	*	*	*	
3	□	*	□	*	□	*	□	□	□	□	□	□	
2	□	*	□	*	□	*	*	*	*	*	*	*	
1	□	*	□	*	□	*	□	□	□	□	□	□	
	1	2	1	2	1	2	3	4	5	4	5	4	A

1 2 1 2 1 2
3 4 3 4 3 4 } B

1 2 3 4 1 2
5 6 7 8 5 6
3 4 1 2 3 4
7 8 5 6 7 8 } C

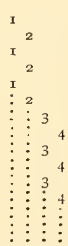
DRAWING IN DRAFT A.



CHAIN DRAFT A.

12	*	*	□	*	□
11	□	□	□	*	□
10	*	*	□	*	□
9	□	□	□	*	□
8	*	*	□	*	□
7	□	□	□	*	□
6	□	*	*	*	*
5	□	*	□	□	□
4	□	*	*	*	*
3	□	*	□	□	□
2	□	*	*	*	*
1	□	*	□	□	□
	1	2	3	4	5

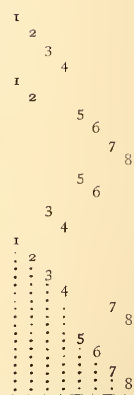
DRAWING IN DRAFT B.



CHAIN DRAFT B.

12	*	*	□	*
11	□	□	□	*
10	*	*	□	*
9	□	□	□	*
8	*	*	□	*
7	□	□	□	*
6	□	*	*	*
5	□	*	□	□
4	□	*	*	*
3	□	*	□	□
2	□	*	*	*
1	□	*	□	□
	1	2	3	4

DRAWING IN DRAFT C.



CHAIN DRAFT C.

12	*	*	*	*	□	*	□	*
11	□	□	□	□	□	*	□	*
10	*	*	*	*	□	*	□	*
9	□	□	□	□	□	*	□	*
8	*	*	*	*	□	*	□	*
7	□	□	□	□	□	*	□	*
6	□	*	□	*	*	*	*	*
5	□	*	□	*	□	□	□	□
4	□	*	□	*	*	*	*	*
3	□	*	□	*	□	□	□	□
2	□	*	□	*	*	*	*	*
1	□	*	□	*	□	□	□	□
	1	2	3	4	5	6	7	8

CROSS WEAVING.—By cross weaving—that is, by twisting the warp threads around each other—the fabrics called gauze are produced. The process of weaving these crossed fabrics should be somewhat slower than for straight work, and the yarn must be strong enough to bear considerable extra strain and chafing. The threads to be crossed must always pass through the same dent of the reed, unless the crossing is done by a needle bar before the reed, some of the warp threads coming through it without going through the reed. The needle bar mechanism is quite complicated; there are several patents in England, and one in this country issued to J. G. Spitzli some years ago. When the crossing is done by harnesses, one thread passes through a regular heddle and a doup or false heddle on a separate frame; the next thread passes between these two heddles, but not through them, and over the other thread. To produce this gauze effect in combination with other textures requires more complicated arrangements. In connection with the jacquard head, most elegant fabrics of this class are produced. This subject is exhaustively treated by Ashenhurst and Barlow. The principle is very useful when inside selvages must be made on a wide loom weaving several widths of narrow goods; by thus twisting a few of the selvage threads the goods may be cut apart; while they will still have a "raw edge," the outside threads will not ravel out.

CRYSTALS OF TIN.—Salts of tin, or muriate of tin crystallized.

CUDBEAR.—This coloring matter is archil in a very dry and powdered state. The color given by cudbear is perhaps less bright, but more permanent than that from archil, but still very fugitive. Although the colors given by it are fugitive, it is used considerably in woolen dyeing for giving the indigo shade to logwood blues, blooming up the dahlia shades and all colors that require a purple shade to them, such as mulberries, peachblows, puces, etc. It is also used with camwood at the present time to bottom for indigo blues, so as to save indigo. The following recipe is used by most dyers for bottoming 200 pounds clean wool, or 400 pounds in the grease: Bail up 30 pounds of camwood, 15 pounds of cudbear; enter the wool and boil one hour; then draw off the tub, take out the wool and extract; it is then ready for the blue vat. Cudbear has all the characteristics of archil, and reagents produce the same results on both. Tartar, ($C\,H_2O_2$) is the only mordant that is of any account for cudbear; it brightens up the color and enables it to resist the fulling and scouring much better. Colors, when archil and cudbear enter into their composition, should be dried in the

shade and preserved from the rays of the sun. Cudbear should be mixed with water into a paste before putting into the dye-bath, otherwise it would float on the surface ; it requires no boiling before the wool or cloth is entered into the solution.

D.

Damask.—Was formerly made of silk only, now of wool or worsted, and fabrics part cotton, with figured texture like the genuine article, are by no means uncommon in the trade under this name, derived from Damascus.

Dandy Looms.—The original Dandy was a hand-loom invented by Wm. Radcliffe, an Englishman. His latest improvements were added to the loom about the year 1802, some time after several power looms had been in successful operation. The general use made of this loom even at that late date shows how difficult it was for many manufacturers to realize the advantage of power looms. Some of the principles which made Mr. Radcliffe's loom noteworthy are still employed on many power looms of recent manufacture.

Dead Spindles.—What are known as dead spindles are but modifications of the live spindles, for the purpose of attaining greater speed. The difference in quality of work from the two kinds is in favor of the live spindle, which seldom performs more than 4,000 revolutions, and is consequently being superseded by much more rapid working devices.

Designs.—W. Dunlap says : "Design, in its broadest signification, is the plan of the whole ; in its limited sense it denotes merely drawing—the art of representing form." There may be a design of the texture, or a design for the arrangement of colors, but a design of a textile fabric, when complete, is a perfect working plan, descriptive and illustrative of the arrangement and character of all the component parts and processes. It designates the kind and quality of the materials, the color, size and character of each kind of yarn, as well as the arrangement, quantity and proportion thereof. It illustrates the construction of the texture, and describes special processes. It provides thorough working instructions for each department. To be complete and perfect, it should be so comprehensive that any good manager could from it produce the desired fabric without further instructions. It should with all be an artistic piece of work. If it is proper to produce working plans for a build-

ing with taste, neatness and precision, surely these requisites are much more necessary in a design which should originate from a perfect knowledge of that which pleases the human sense of sight. The practical use of a complete design is that of a chart of instructions, which remains at headquarters for reference and future use. The several departments are given copies of their respective parts of the design. Many designers object to furnish copies of designs for future use, under the foolish impression that by this means they enhance their own value. A more ridiculous theory would be hard to find; worse than this, the design is the result of labor for which the designer is usually well paid, it therefore belongs to the employer, and the designer should take every pains to make it legible to any good workman, in order that it could be produced at any time without the aid of the originator. We are aware that this is not a popular doctrine among a certain class of designers, but it is none the less sound. Without reference to unnecessary detail or decoration of designs, the statement may be safely made, that a design in its appearance on paper should exhibit skill and taste quite as much as the fabric for which it is executed. To this end, some education and practice is an absolute necessity. The simplest design may, without waste of time, be a specimen of neat and intelligent workmanship.

DESIGNERS.—For a time many manufacturers of this country thought to economize by dispensing with designers and requiring the overseers of the weaving rooms or the superintendent to do the work. They found many ambitious and jealous workmen to encourage this move, but a large proportion have learned that the change was not all clear gain, and have already re-engaged designers. Some few have also profited by former lessons, and never allow the ambition of a designer or the jealousy of a superintendent to get the mastery over them. The prevention is simple; the superintendent and designer are given clear instructions as to their authority and relation to each other, and the matter of promotion is also positively qualified. The designer has no reason to hope for the superintendent's position if the latter vacates his place for any other reason than such as can in no way reflect any suspicion of intrigue upon the designer or his friends. The designer is not above, but under the superintendent, and can be removed by him. Under these circumstances it is an easy matter to regulate both, and should ill feeling arise the power and influence is not equal. The designer cannot revenge himself by working out the superintendent, nor is the latter tempted to proceed any differently

in discharging the designer than he should do with any other workman. That the labors of a designer can be thoroughly attended to by one who has other duties to occupy his mind and time is out of the question, unless the amount of designing to be done is very limited. The designer should have no other operatives under his special authority than his assistants and the pattern weavers; he should, however, have a most influential voice in decisions relative to designs, patterns, colors, finish and such matters as materially affect the result of his labors, subject always to the superintendent's decision as to the possibility and practicability of carrying out such details as he may suggest, in the factory in question. As regards the education of designers, it must be acknowledged that America is yet far in the wake of England, France and Germany. Too much dependence has been placed upon the natural adaptability of American citizens to almost any convenient calling. The special and thorough training under the direction and supervision of practical as well as expert tutors has but of late awakened attention, and even now many of those who should be the most forward in aiding every effort to supply this want are carefully pinching their dollars and waiting for some one else to bear the brunt of the battle. But schools for the practical education of the rising generation must be established in this country, else the ground lost by the lack of them will be greater and greater, as mechanical genius increases the demands upon mental ability.

Designing is a branch of textile manufacturing of such importance and peculiar requirements, that it can be performed thoroughly and correctly by those only, who have more or less natural qualifications for it. It is exceedingly tedious and trying work under the most favorable circumstances. When the designer seems to be idly staring into vacancy he is perhaps laboring in a most trying manner. He must develop a design in his mind, to a certain extent, before he can proceed to commit it to paper. Designing a texture is not enough; a complete design comprehends everything pertaining to the manufacture of the finished fabric; neither does designing stop here. The design will be almost useless if it calls for expenditures so great that the manufacture of the fabric will yield no revenue to the manufacturer. In designing a fabric then, the details of all the processes, the nature of material, dyes and effects must be considered. To fit the young designer not only to perform these duties in their entirety, but to train his mind to a realizing sense of the importance of every detail, requires far more time at present than need be spent in preparations. The cost of time and impossi-

bility of obtaining ready encouragement in many instances deters really promising young men from making a determined attempt to master this art.

Design Books.—A careful record of designs, however familiar they may seem, is a great advantage in after years. Notwithstanding this matter is sadly neglected by many it is of paramount importance. For this purpose design books are supplied. To be convenient they should contain design paper, ruled or printed (or both), to suit the character of designs to be recorded, by this means a somewhat tedious task is made easier, and the result is much more satisfactory. We know of old men who have made designs enough in their day to be now worth several thousand dollars if they had been properly recorded. As an instance of special ruling for design books, those now to be had for designs of fancy cassimeres will serve well. The pages should be ruled in sections. There may be either two, four or six sections, or even more in the width of a page; each section to be about as wide as 30 columns of squares. The length of the section is not so arbitrary; yet, when too long the book becomes inconvenient and space is wasted, when too short many designs will be too long and have to be continued in the next sections, which is very inconvenient. These sections are ruled alike horizontally, but only each alternate one is ruled perpendicularly to make "quadrille." The left hand or first one (ruled only one way) is for the record of warp and filling, and the other for the Drawing-in draft and chain draft. By being careful to keep the enumeration of the threads of the warp on the same lines with the numbers of the respective harnesses, and the enumeration of the filling threads upon the same lines with the respective bars of the chain draft, much trouble and confusion will be avoided, and neatness will be a marked feature of the book with a little care.

Design Paper.—The selection of design paper being now possible, it is no longer economy to use one kind only. For large patterns—particularly jacquard designs—the fine lithographic paper is a necessity. Even this comes in large varieties, that the designer may use paper to suit his work. Different sizes of squares and blocks, different colors of print and qualities of paper are the essential differences. Ruled paper cannot be made so fine and regular as the printed paper, but it comes comparatively cheaper. If for the large designs, we use finer ruled paper, and for the smaller ones coarser ruled, the convenience in writing and reading will be very remarkable. Large designs on finer paper, although

they must be wrought much finer, are easier to work and read, because the area is not so large as on coarser paper, and the latter when used for smaller patterns will still be kept within convenient bounds and make reading easier. Different sizes of sheets are also very essential. Woolen mills which have a set way of writing their drafts can save much paper by having their design paper ruled to order. The form of ruling suggested for Design Books is very good. Design paper should never be kept rolled up It is the best way to transport it in small quantities, but if kept so will get out of shape. Pads are very good on this account.

Designing Rooms.—That designers should have rooms, well lighted and ventilated, large, convenient, quiet and inaccessible to any one but those who have important business there, is a fact, but the importance of it does not seem to penetrate some craniums. Designing is work which requires the closest application of mind possible; if a mind is thus engaged, interruptions, inconveniences and unnecessary difficulties not only cost time but a far greater tax upon the mental powers. A poorly lighted room, therefore, is a loss to the employer and an injury to the persons who must work in it. A designing room should not be on the first floor of a building closely surrounded by others of the same or greater height. East, west and north windows, with convenient curtains and blinds for modifying or shutting out the light, are necessary. If only one side can be lighted the north light is usually preferred. The matter of ventilation in rooms where persons must stay for hours at a time is now pretty generally understood, but sadly neglected. Few designers can do their best when cramped for room; this will be appreciated by those only, who have had many designs to keep track of, sometimes several in hand, and those who know how many conveniences and apparatus are needed, which should have convenient places provided for their storage as well as use. Perfect quiet is a great help; for this reason, the designing room should be separate from all else; the pattern room, where the racket and jar of the pattern looms seldom ceases, is no place for close application of mind. To keep those out who love to impose their presence wherever or whenever they are not wanted is quite a task in a factory if the arrangements of the rooms cannot in a measure be depended upon. The furniture of the room is a matter of no little importance, but few designers agree in the details they require. A large table, a low and a high desk, shelves and drawers in abundance; also, racks for sample yarns should always be sup-

plied. Chairs or stools are a matter of choice, best left to the one who is to occupy them.

Dissecting.—Is dissecting or "picking out" necessary; if so, what is the best manner of procedure? To answer this double question it will be necessary to consider what is understood by dissecting; if getting at the texture is all, there are many patterns which need but a glance to satisfy one who has had much experience. But if dissecting in its full comprehension is considered, the character of the finish, colors, threads and fibers must be ascertained, as well as the particulars of the texture. How any one can do all this with the naked eye, or without picking to pieces even to the very fibers, and not jump at some conclusions, is a problem the solution of which will probably never appear. One needs to read few notices like the one from which the following quotation is taken to become convinced that the time has arrived when the means of distinguishing fibers are imperative: "Mr. Gideon Hamilton has, after much research and experimenting, succeeded in discovering a chemical process by which the fundamental difference between animal hair and wool fibre is actually removed. It is well known that the difficulty of employing wool and cotton or hair simultaneously for textile purposes arises from the fact that both materials cannot be homogeneously spun and milled or fulled. The cause of the difficulty exists in the different natural structure of the two kinds of fibre: the animal hair being straight and slippery, while the wool fibre is curly and crisp. The point of the new invention is this, that by the agency of certain chemical substances the animal hair is so efficiently curled that it permanently retains its altered structure during all the manipulations of manufacturing cassimeres, cloakings, felt goods, etc., and can be dyed equally fast together with wool by one and the same process. The importance of this invention is obvious. First, an organic combination of animal hair and wool fibre is produced; secondly, a splendid substitute for shoddies and artificial wools is found." But it is not only to find the kind of material used in a sample to be dissected, that fibers must be examined as never before. The character of a fiber, the effects of various processes upon it; the direction and amount of twist and many other details are often necessary to produce a peculiarity in appearance which may be the only special merit of the piece of goods in hand. The less a man knows about special requirements of his calling, the louder is his ridicule of all their claims as a necessity to perfect work; but the time has passed and gone for designers of this kind. Manufacturers are rapidly awaken-

ing to the realization of the fact that to compete with Europe the designers employed must be of the most advanced kind. The best operatives, stock and machinery can be employed to the best advantage, only when the factory is supplied with the most accurate plans, in which economy, product and good effect are well combined. Having given sufficient evidence of the need of dissecting in its entirety, some suggestions as to method will be in order. Few who ask to be shown the method have any inclination to be methodical, yet this is one of the most prominent characteristics which must be practiced and developed. We recommend that the texture be ascertained first, because while doing this threads are drawn out; these, if carefully preserved in their proper order, may themselves be dissected in due time without further mutilation of a sample, be the sample large or small; this is a saving of time, if nothing more. Gesner gives no instructions for dissecting the texture, but says:

"Every woven fabric is composed of two sets or systems of threads or yarn. If it is necessary to follow a certain specimen in hand, the following questions present themselves:

(1.) Which are the warp and which the filling threads?

(2.) Of what material are they made, and what are their special characteristics?

(3.) How many warp and filling threads are necessary?

a. Which are the warp threads and which the filling?

(1.) If on the sample in hand there is a bit of selvage the question is readily answered, since the selvage always runs in the direction of the warp.

(2.) Are the threads one way doubled and twisted, and the others single, it is almost safe to take the twisted threads for warp.

(3). If the threads one way are single or double cotton and the others single woolen yarn the cotton is almost invariably the warp.

(4.) Do the threads of one set or system produce a regular or set effect, the other less prominent and irregular, the first are the warp, the latter the filling threads without doubt.

(5.) Are the threads one way sized, the others not, the latter must be the filling, the warp having been sized before or while weaving.

(6.) Do the threads one way appear straight and regular, the other way loose, rough, displaced or not strictly regular in their own direction, the straight yarn may be safely assumed to be the warp.

(7.) Reed marks of any kind will show which is the warp.

(8.) The nap, if any, is very reliable, as it is supposed to lay in the same direction with the warp.

(9.) The twist in the yarn is often the best means of answering this question, the hardest and strongest thread is the warp.

Exceptions to these instructions occur but seldom. In many fabrics the difference and the reasons for said difference in the yarn are so clear as to require little examination. That the warp thread is usually the smoothest, strongest, also of the longest and best material is a very safe rule to follow.

b. Of what material are they made?

While examining the yarns to decide the first question, the answer to this is often obtained without further effort. The size and twist of the yarn should have especial consideration. To distinguish the material requires perfect familiarity with the peculiarities of all kinds of materials, raw and manufactured. Even when such experience or knowledge is possessed, careful comparisons are the safest in a final decision of importance.

c. How many warp and filling threads are necessary?

The density of the fabric is altogether controlled by the texture and required weight and thickness. The manner of designating this density by special and appropriate terms has been very diversified by the different systems of calculations employed in different localities. The Technological schools now so numerous are doing much to establish a uniform system of calculations by which the density of yarn in fabrics is estimated by the number of threads and dents in reed per inch or centimeter."

To dissect the texture proceed as follows:

First—Determine either by the nap or by the difference in the strength of threads drawn from each side, which is warp and which is filling. Many patterns display the fact so clearly that the above precautions are unnecessary.

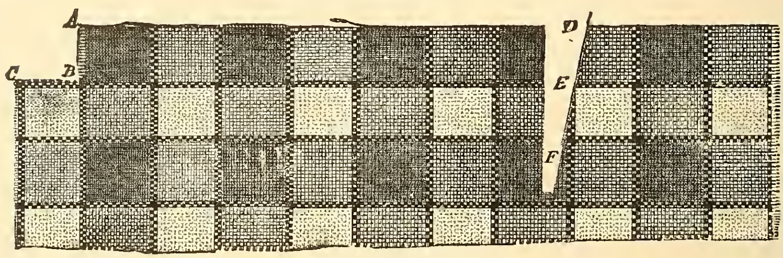
Second—Shear the nap from the back and face as far as necessary at the right hand lower corner. For this purpose use curved scissors; shaving is dangerous, the threads are so easily weakened; neither is singeing advisable, for the smut even from the smoke of a spirit lamp is disagreeable, and it is more than likely that too large a surface will be bared, the colors affected by the heat, or, even worse, the thread charred so much as to break when being drawn out. Of course experience will teach one to do almost anything, but the safest way is best for most people.

Third—Having thus prepared the sample proceed to cut out a little piece of the lower right hand corner, as shown in figure No. 1 by the lines A B C. Save this little piece, it may be of use after-

wards. Next turn the sample until the cut corner is at the upper left hand, as in the illustrations. The corner to be cut is designated as the lower left hand corner, because it is taken for granted that having found the warp and filling, the sample will be held in such a way as to have the warp in the perpendicular direction, the filling horizontal or lateral, and if the cloth has a nap, that the nap lay downward as worn in a garment, and that it will always be so held, when under consideration, unless reversed as above directed. The reversing is an obvious precaution after one has observed how much easier a filling thread comes out with the nap than against it.

Fourth—Make a straight cut from D to F; this should be in the third pattern from the cut corner. To make the counting of patterns easy let some prominent or conspicuous thread, if there be any, remain as the first thread; elongate or shorten the space, A B C, to obtain this desideratum.

FIG. NO. 1.



NOTE.—The engraver has failed to be systematic in his work. The cut D E F should be in the same place in all three figures at the beginning of the third pattern; it need not be so wide, or always so long. In No. 3 the marked threads are not represented as regular as they ought to be.

Fifth—Fasten the sample to a piece of card board (or one of the sample stretchers which can now be purchased very cheap) with a few but firm stitches. Then the card is slipped under the stage springs. All this and some of the following is to be omitted when no instrument is used, in which case the sample is held stretched over the left forefinger, by the thumb at one end and by the second finger at the other end.

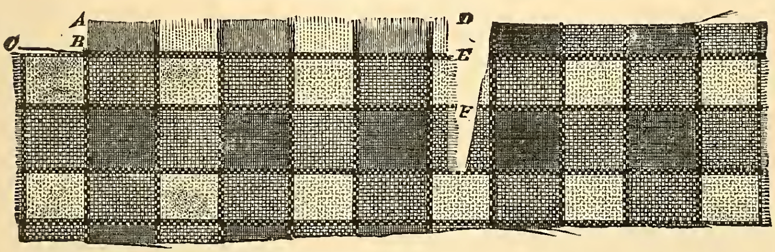
Sixth—Next ascertain which lens is necessary to give a clear view of the threads, always bearing in mind that as soon as the lens is so strong as to magnify the fibers too much they come into prominence sufficiently to be really a confusing trouble. To ascertain which lens to use will fix the focus as well.

Seventh—Having the microscope and sample in readiness, draw out with the greatest care one filling thread after the other until all

the space is clear, as in figure No. 2. This should always be done under a magnifying lens, even while a lack of practice makes the task slow and more difficult. Use a pair of forceps to draw the threads if possible; they do not split warp threads like the needles. The great difficulty occasioned by threads which have been split or untwisted by the needle in this necessary preliminary process will soon teach one to take every precaution to avoid the difficulty; one of the results of such a lesson is that the aid of a microscope will be courted for this part of the work, even when it can be dispensed with further on. The threads drawn out should be saved in their regular order; this will afford much aid in determining the order of the filling threads, serve as samples of the yarn for dissection, and to be used as guides for the dyer, etc., etc.

Eighth—The projecting warp threads should now be examined; if there are not several threads especially conspicuous, on account of color, size or kind, some of them should be marked either by staining or shortening to serve as tally threads in keeping the count

FIG. NO. 2.



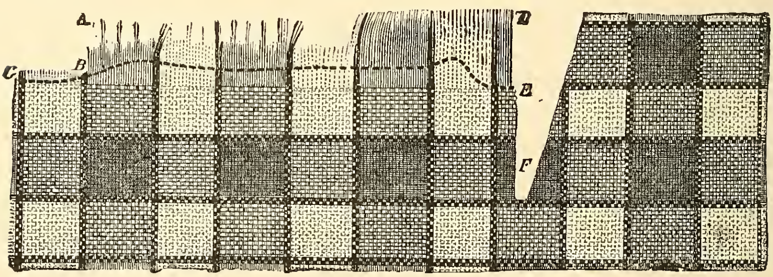
correct. Brush out all the loose fibres in the projecting threads. This done, draw forward the first filling thread just enough to loosen it from the fabric, when the sample should appear about like figure No. 3. All these preliminaries are tedious, and one is tempted to slight them, but this should never be done; many seconds spent in preparing will save long minutes in the work to follow, to say nothing of discouraging annoyances.

Ninth—To prepare the paper for the reception of the draft, as taken from the sample, should be next attended to; mark off as many perpendicular columns of squares as there are projecting warp threads in two repetitions of the pattern, each of these perpendicular columns will then represent a warp thread, and should be marked at the top if any of the threads have been marked, or are otherwise conspicuous. Always ascertain if there are any backing warp threads; if so, also, the order in which they occur, and mark the respective columns on the paper.

Tenth—Examine the sample and paper carefully to make sure that every detail has been observed and complied with. Mentally assign the lateral lines of squares upon the paper to represent filling-threads, for they are next to be filled in the same order as would be adopted in common writing.

Eleventh—Everything is now in readiness to read off the texture; note how the warp threads cross the loosened filling thread, whether over or under it; if over it, prick two holes in the corresponding square, one if under, noting each warp thread *in its regular order* (a very important point, wherein the inexperienced meet the most difficulty); having filled all the spaces of the first lateral line of squares as far as previously marked off, if sure there is no error, the filling thread may be taken out entirely, the loose fibers brushed out, and the next filling thread loosened; the lateral line of squares represent the filling threads in their proper order as the same squares in perpendicular lines or columns represent the warp threads. Thus, proceed with each filling thread, marking each line at the left hand if any difference exist among them in color, size or

FIG. NO. 3.



stock. When enough has been picked out is a matter which each man's experience will teach him. Some can tell after the first few threads how the rest will run, but the beginner should continue until the pattern begins to repeat the second time. When some one is ready and willing to write the marks into the squares as called off, much time is saved. Some drop the dissecting needle to pick up pen or pencil rather than prick the paper, or they use a slate or pegging board, but this is all a matter of choice. Some textures can hardly be dissected from the filling sides, but these are exceptional cases; when they occur, reverse the sample and proceed as if the warp were the filling. The marks will then be right on the paper only when also reversed, as in Ashton's instruction.

Twelfth—The next move will be to deduce the drafts from the memorandums taken from the sample. To do this, proceed as in deducing drafts from designs originated. (See Textures.) As regards the use of instruments, little need be said; they make a way into every thinking man's favor with little help. While some authors recommend magnifying glasses for cotton only, others reject all optical aid. While some advise a shawl pin for a dissecting point, others call for a coarse needle in a piece of wood for a handle. Indeed, so many opinions have already been expressed, and so arbitrarily, to say more seems to be adding to the confusion. By calling attention to points not brought to notice by others some good may be done. First, then, as regards optical aid, we hold that the strongest eyes cannot endure the tax of picking out continuously for any length of time, but by the use of instruments suited to the work and the eyes, this time may be prolonged and the work done with greater ease and accuracy. In place of proper dissecting needles the shawl pin may do for Scotch cheviots and the like; the coarse needle may be an improvement upon the pin, but neither of these are a credit to a man who follows a calling, the life and soul of which is a natural disposition to habits of taste and neatness which alone can beget the same characteristics in designs. Furthermore, a dissecting needle should not have a point like a pin or sewing needle, but should taper regularly from the point to within one-third of the length from the base, and nearly all of this one-third should be taken into a delicate but firm and strong needle holder, which will permit a change of needles to suit the work. Four or five different kinds of needles should always be at hand, three sizes of round pins, one or two sizes of straight flat needles, and at least one size of bent flat needles. The flat needle has the advantage of affording strength and less obstruction to the view than a round one, while a bent one allows a different angle for the holder, sometimes necessary when working with a short focus instrument. The other instruments which are almost as indispensable as the needles are a pair each of very fine, delicate, curved, elbow and straight scissors, a pair of good stage forceps, at least one good dissecting knife, and some linen provers to use separately or with microscope. The curved scissors admit the blades close to any flat surface; with the elbow scissors one may make a cut in a mounted sample when on the stage, while the straight ones are always needed. The forceps will pick up a fiber, thread or even a bit of flocks that would be too small for the most delicate fingers; when once accustomed to them they will be found so convenient that they will be in

constant use when dissecting. The dissecting knife is often needed to cut where or what the scissors cannot reach. Linen provers, with or without lenses, are nothing more or less than gauges whereby the threads may be correctly spaced and counted.

Other methods are recommended by various authors; one of the instructions recently made public, direct the operator to fasten the sample to a circle made by pasting the two ends of a strip of card board together, but fails to point out any advantages in favor of this novel contrivance for filling the hands with unnecessary articles. A better method when a sample is to be dissected for the texture without optical aid, is to sew the sample to a round ball of convenient size upon the end of a suitable handle. The ball, when smoothly covered with a knit fabric, is a good foundation upon which the sample may be fastened quickly. There is no trouble in procuring these ready-made. Ashton recommends the following order of proceedings: "When a draft is required, examine the cloth to see if there is any nap on the back of it; if there is, it should be burned off by means of a lighted match, care being taken not to burn the threads. If the sample should be a cotton pattern, a magnifying-glass must be used. Next, remove as many of the filling-threads as will leave about one-eighth of an inch fringe. If there are any double and twist threads in the warp or filling, always commence with them. Remove as many of the warp threads as of the filling. When raising the threads be careful not to split those of the warp. Now, having the sample prepared, take it in the left hand between the forefinger and thumb, holding it so that the second finger may secure the threads as they are picked out. Commence at the right-hand side of the sample. Note down on the designing paper all the threads on the filling, and call them so many threads *on*; and all the threads under the filling, call them so many threads *off*. Leave as many blank checks as there are threads under the filling. Continue to work thus, until the pattern repeats itself in both warp and filling, and the draft is complete. Sometimes, however, there are repeats in samples; these can be found by taking out two threads more than the pattern so called, and if both repeat, then the draft is correct, but if only one repeats, trace the draft until both warp and filling repeat. The next thing is to reduce the draft. At this point, do not forget that it is the filling that has been picked out, therefore, after the draft is complete, turn it round one square from right to left, and let the reduction begin at those lines representing the warp. Strict care must be taken that the threads are drawn into the heddles as indicated in each harness, otherwise the work will be a

failure." Burns gives instruction in more minute details, but very similar in general principles. Baldwin differs more, and is by many considered more clear and to the point than the other two. The fact is, each has some good features to be commended, and all should be studied after the beginner has made progress enough to be able to judge them fairly.

Dissecting the Yarn is now necessary. The information which is to be ascertained is important; therefore, no pains should be spared nor any part of the work hurried. The size of the threads, the amount of twist, stock and colors, if a mixture, are the principal points. The nature of the color should also be investigated. To find the correct size of the threads in a sample there is but one way positively sure, that is to pick out 36, 72, or 144, just one inch long without tearing them in the least. Weigh these; having thus found the weight of one, two or four yards of yarn, the size is easily estimated. But the difficulty lies in getting these threads. Sometimes it is impossible; at all times too slow if one has acquired a good judgment of sizes and the allowances necessary for the take-up of yarn by the curvature caused in each thread by the fabric. Precision and accuracy are best attained by much practice with samples, the size of which is positively known. Be the size ascertained by weighing, judgment, or guess work, it must not be taken for granted, but proved by estimating the weight of one yard of cloth from it. To do this the threads per inch each way must be found. The threads per inch in the warp must be multiplied by the number representing the width of the finished goods, the threads per inch in the filling by the number representing the width of the warp in the reed, in inches. The proportion of each kind of yarn in a pattern being known, the same proportion holds good in a full yard of the goods: when found, the quantity of each kind of yarn per yard is found in ounces by means of the yarn number, (ascertained in either of the three ways above mentioned.) Add all the weights together. If the sum of the weight per yard, with proper allowances for shrinkages, etc., proves correct, or as wanted, the estimate of the size number is right; if not, proceed to revise the numbers until the work does so prove itself. In counting the threads on a piece of cloth, it is a common practice to use a fraction of an inch as a gauge. The errors which are liable to creep in this way are worth a moment's consideration. Let us suppose a $\frac{1}{4}$-inch linen prover or pick glass is used; a portion of a thread projects within the gauge; it is only a small portion, say one-fourth of the thread, but it is dropped; this makes one thread

missing per inch; in 54 inches it is 54 threads, quite an item. Larger gauges, then, are a decided advantage, particularly when counting coarse yarn; when counting the threads by patterns or fractions thereof, a two or three inch gauge should be used. The amount of twist is easily counted by laying a thread under a gauge upon a card, and placing them under a microscope. The fibers in each thread may also be counted under a good glass, and the proportions of mixtures ascertained to a certainty, the nature of the colors will be obtained at the same time. The stock is a matter of consideration requiring a deal of sound judgment, but the microscope is a great aid in discovering peculiarities. The stock in the sample should be known even when another class of stock is to be used in the imitation, else how can a fair judgment of the final difference be attained. In dissecting threads the fibers are sometimes unruly on account of electricity upon clear cold days; a very little moisture applied to the stage of the microscope or the card upon which the sample threads lay, does away with this difficulty.

Dobby Loom.—The peculiarity of the dobby loom is in the application of a small Jacquard motion to work the harnesses. The Crompton Loom Works have turned out large numbers of light, rapid looms under this name during the last few years; in these the pattern is put upon the loom in a peg chain.

Doffer.—Upon a carding-machine the cylinders which deliver the stock to the combs or condensers. In the spinning-room the operative who doffs the bobbins. The card doffer should always be kept in the best of order, the wire should be fine and of good quality.

Domeck.—An English name for an inferior grade of damask.

Doubling.—Doubling the stock, while in the several slivers, has for its object regularity and evenness. It takes but little thought to comprehend the advantage of as much doubling as can be done judiciously; there would indeed be no such thing as excessive doubling if to double many times the slivers did not need to be of certain sizes not always suitable to the stock, to say nothing of extra labor, destruction of material, waste, etc. Doubling yarn is resorted to, to gain strength and regularity. The ring and cap frames are the most rapid doubling-machines, but the quality of the work is not equal to that from flyer frames. The doubling from mules, well fitted up for the purpose, is the most perfect work of this kind at present attainable. It is a matter of much comment that the best

manufacturers of France and Belgium can spin and double many kinds of yarn more evenly than the same class in England or America. The secret is largely in the fact that they do their best work with mules; and yet many of their mules are built in England.

Double Cloth.—Double cloth is referred to, and some textures given under the head of Textures, but Ashenhurst's remarks on the subject are so interesting that we quote a few leading paragraphs here: "Double cloth is a branch of fancy weaving which is not practised generally, being confined to the woollen and carpet manufactures chiefly, and very little used in the cotton, silk or worsted manufacture, except occasionally in the latter branch for coatings, in which case a woollen back is woven on for the purpose of giving weight and warmth. Double cloth is for the most part composed of similar fabrics, which are sometimes interwoven at intervals and formed into a diversity of patterns, the two cloths being of different colors, the one color forming a pattern on the other. Double cloths are of three kinds, one formed with one warp and having two weft surfaces, the second formed with one weft and having two warp surfaces, and the third being two distinct cloths."

Double Velvet.—This term alludes to the manner in which the goods are woven rather than to any special peculiarity of the finished goods. Two fabrics are woven together face to face; afterwards severed with a knife; the ends of the threads cut to separate the goods, constitute the pile or plush on each. It is difficult to make the pile even in this way. Numerous inventions to aid the weaver in this difficulty are extant, but as yet none that insure the perfection that may be obtained by weaving the goods single.

Dusters.—Also called Willows, or Willeys, are used for opening stock and removing dust, sand, etc. They are provided with a cylinder revolved at a high speed containing pegs, pins or teeth; under the cylinder is a screen which allows the fine rubbish to pass through it into a receptacle underneath the machine. The stock is thrown out by the cylinder, either continually, or when the case is opened for the purpose.

Drafts or Draughts.—The word draft is made use of for such a variety of meanings in textile factories that its true application and derivation seems to be a matter of doubt. For convenience the two ways of spelling are separately employed in this work, Draft being used for the applications under this head, while other defini-

tions and remarks may be found under the word Draught. Perhaps it would have been better to adopt one word, but even in this way, each will have several definitions; certainly, as regards the convenience, there can be no doubt. The same words being frequently used in these pages, it may be well to state that draught is used only in connection with the draught or drawing of yarns, while draft is used in various connections with designs. The use of this word, instead of the more correct verb, dissect, by several authors has misled many. The true application of the word is, no doubt, in direct connection with the sketch of a texture made while dissecting, and may without great error be extended to preparatory sketches of designs. Custom has established the use of the word for parts of designs as well. This custom is so universal in this country that it is adopted in this work without hesitation. Under the head of designs will be found the remark that the design is not given into the works complete, but in sections or parts commonly called drafts. These drafts are variously executed, and of course depend very much on the kind of goods and factory. A few of them are here explained in the order delivered in some first-class woolen factories.

Spoolers' Drafts specify the number and kind of spools, quantity of yarn on each, and how to be prepared for the warper. The threads or ends upon each spool should always be given, if more than one. If several kinds of yarn are to be put on one spool, the number of threads of each should be stated; also, any other particulars necessary to make the preparations of the yarn for the warper clear and correct.

Warpers' Drafts are very similar to the spoolers, but have, in addition particulars of the divisions, sections or smallbeams, the width of the warp, the yards per piece, and the number of pieces or cuts total. The number of patterns per section, the number of threads per pattern, and their regular order is, of course, necessary.

Drawing-In Drafts.—These are the instructions to the drawing in hands, by which they may readily see in what order to take the heddles upon the several harnesses for the purpose of drawing the threads into them. These drafts should be written on a large quadrille paper. For the designer the finer quadrille is much the most convenient, but when the mind and hands are occupied with tangled heddles, it saves time and errors, if the instructions can be read with ease.

Chain Drafts.—The chain draft shows how the several harnesses must be moved for each pick. They are written on quadrilled

paper (the larger the better for chain builders), each little square represents a respective harness, the first perpendicular column is devoted to the first or front harness; the next for the second, and so on, until each harness required for a fabric has such a perpendicular column to represent it; by making the first pick of all the columns come on a line, we are enabled to read on each line the position of all the harnesses when the shuttle is going through, thus in the following examples of one pick we would read the marks:

1—	*	□	□	*	*	*	□	□	□	□	*	*	*	□	□	*
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

One raiser, two sinkers, three raisers, four sinkers, three raisers, two sinkers, one raiser; because the heavy marks are put in to represent the ball, button, peg or any other device put upon the bars or cards of the chain, to govern the jack which lifts the harness. The light marks show when the device for lowering the harnesses is to be operated. As each line of the draft represents a pick it also represents a bar or card of the chain. Chain drafts should be written on heavy paper (quadrilled on one side only) with a wide margin on all sides, because, being often handled by the edges, they become soiled and should be trimmed before filing. The chain draft is written directly under the drawing-in draft, and to the right of the filling draft in a complete set of drafts, and in the design. When copying drafts for the several departments (especially upon the chain draft) any special thread or threads, which must always appear in the same pick or harness, should be legibly marked; from the above arrangement of the entire design this is very easy. The columns or harnesses should be numbered at the bottom from left to right. On the left sides the lines or picks should be consecutively numbered, some begin at the top, others at the bottom to bring the beginning of each set of figures in the same corner.

The Filling Drafts are made out in many ways; designers seldom do more than give the order of threads per pattern and number of picks per inch in loom. But a filling draft should also show the working of the shuttle box motion. As different box motions require different kinds of chains or devices for governing them, the variety of filling drafts is great. Some designers, however, designate the number of shuttles to be used and the order in which the respective boxes are to be brought to the shed level. This is simple when the boxes are numbered, the shuttles lettered or named by the kind or color they carry. The instructions for

raw material—those to the dyer, carder and spinner—may all be copied from the complete design, but they can not be called drafts.

The word draft has yet another significance in factories; its influence on different kinds of work varies, but in cotton or woolen factories a draft is at all times bad in the carding and spinning rooms. Especially in worsted drawing rooms should the ventilation be such as to keep the temperature even and the air good without a draft from any source. Leroux says: "These work rooms should be well closed to prevent drafts from modifying the temperature, which should be as uniformly as possible—about 20° of the centigrade thermometer. Besides varying the temperature, a draft will increase the evaporation of necessary moisture, and difficulties from electricity, besides blowing about the stock and small particles of waste.

Drafting.—This appellation, instead of "dissecting" or "picking out," is common in some districts and used even by some authors, but it is not strictly correct, as will be readily understood by a careful study of the proper application of the word "draft." No doubt the word is misapplied from causes arising altogether through misinterpretation of the words "draught," "draughtsman" and "draughting."

Draught.—The draught of a drawing or spinning frame, or any other machine, is the process of drawing the stock, whether in a web, sliver or roving. Also the mechanical devices for drawing, and the distance or amount of drawing done. The calculations of draughts are very nice in some yarns, while in others a pretty good guess does very well. Each one who has any drawing of stock to look after should be well acquainted with the various ways of producing desired results in the most accurate manner. Much experience is required to know stock well enough to judge the amount of draught it will endure or require.

Drawing.—The Textile Designer should by all means be able to draw. While dealing with elementary textures the work is very simple, but larger designs can not be executed neatly, when no artistic skill is at command. "Drawing is the A B C of the architect, engineer and surveyor." (Sir Isambarn Brunnel.) "Drawing supplies us with a power whereby long descriptions and pages of writing are at once superseded, and thus it is a condensed shorthand as well as a universal language." (R. Redgrave, R. A.) Since every textile design like the work of the architect, must be wrought out with mathematical precision, the production thereof may

properly be classed under the head of Mathematical Drawing. Without discouraging any ambition to free hand drawing, we would recommend a thorough practice with mathematical instruments first. The best method for those who can not place themselves in the hands of a good tutor is to buy a standard work on mathematical drawing, mathematical instruments and drawing materials. The first book of our choice would be "Mathematical Drawing Instruments and How to Use Them," by F. Edward Hulme, F. L. S., F. S. A. A book of this kind is as great a necessity as any the beginner can procure.

Drawing Materials.—Of drawing materials quite a variety are needed to complete a designer's outfit; on the subject of paper, pencils, etc., etc., the book above recommended contains very valuable information.

Drawing In.—This term refers to drawing the ends of the warp threads through the heddles, mails, etc. This work is sometimes given into the hands of children, or grown persons who are worse than many children, to save wages. It is a poor economy; errors made here are seldom discovered until the cloth shows it; the time and expense to make it right are usually a serious tax. Drawing in should be done with a hook, which will not strain the eye of a new heddle. First, because the eye of a new heddle should have the best shape possible; second, because the hook, to strain the heddle, must bind; if a thread happens to get between the hook and wire it will probably be broken or cut, causing delay and a knot, both of which should be avoided everywhere. To draw in a cross draw, the operative must read the draft frequently; the sole dependence upon memory, after reading the draft a few times, is something people like to boast about, but it is not the best method even with a good memory. The drawing in is sometimes done on the loom by twisting the ends of a new warp to those of the old; but the practice is not so common as it once was.

Draw Boy Machines.—These are devices employed to assist the draw boy in raising the "lingoes," which, when many in number, were very heavy. This device, as well as the looms upon which they were used, are very fully explained and illustrated by Barlow.

Draw Looms.—The draw loom is fully explained by Barlow, whose introduction of the subject alone is very instructive. Ashenhurst has also several pages of interesting matter on this subject.

Drawing Frames.—There are so many kinds needed for the different kinds of work, and opinions vary so much, that we quote Baird on cotton drawing frames and Leroux on worsted:

"Drawing or doubling is the next operation through which the cotton has to pass after it has been carded. The ends, bands or slivers, as they come from the card, are exceedingly tender and loose, the fibers of cotton not being yet arranged in the parallel form requisite for good spinning. Before any twist is given to the bands, the fibers should be in a proper position for the manufacture of smooth yarn. The doubling and drawing out of the bands, which accomplishes this perfectly, is done on the drawing-frame. Some drawing-frames are constructed with three pair of rollers, and some with four pair; the latter having the advantage of doing more work in the same time. The rollers in a drawing-frame are generally so adjusted, that the drawing is done between the first and third roller, the middle roller having but little influence on the result, so far as the stretching is concerned. Where there are three or four rollers, the drawing is performed twice; each pair of rollers draws a certain amount. The distance between the rollers is so adjusted, that the longest fiber of the cotton does not reach from the centre of one roller to the centre of the other; this prevents the rollers from tearing the fibers, because the first pair of rollers pulls the fibers, while the second holds them fast. If, on the other hand, the distance between the rollers is too great, the filaments of cotton separate in unequal thicknesses, and the result is unequal yarn. It is more preferable to have the rollers too close together, than to have them too far apart, provided they are always so far distant as not to injure the staple. The principal object to be attained in drawing the bands is, to reduce their thickness after they have been doubled. Doubling and drawing effects the two-fold purpose of stretching the fibers of cotton, and equalizing the bands. The more a band is doubled and eliminated, the more perfect should be the yarn spun from it; but this process of drawing can, nevertheless, be carried too far. Excessive drawing, as well as excessive picking and carding, tends to weaken the fiber, and finally renders it brittle and rotten. Still, if the machinery is kept in such perfect order as not to injure the cotton, it may be considered impossible to eliminate the fibers to too great an extent. The sliver from the last drawing-head should be of a silky lustre, and its component fibers should lie perfectly parallel with the band and with each other. But little cotton is wasted in this operation; the waste consists principally of those parts which have to be broken off in consequence of their

running singly, or when the attendant, through negligence or inadvertence, misses a can, and gets behind-hand with the rollers."—*Baird.*

"The preparatory machines consist of a series of drawing frames of different sizes, in which the number of rollers varies; for, each machine being called upon to reduce the slivers, the numbers of cylinders ought to go on increasing in proportion to the amount of thinning the slivers have to undergo. The drawing process has for its object to reduce the volume of a certain quantity of wool slivers, while it preserves their original weight, with the exception of a slight loss in flyings and wastings, resulting from the drawing; for, during that process, either loose filaments become detached from the slivers or bits of wool are separated and get wound round the comb. When this latter case occurs the waste is carefully collected and a skilled workman draws it by hand so as to repass it the next time; but the waste which falls on the machine or the floor is generally so short and poor that it is almost impossible to subject it to that operation, and we must be satisfied to shake it up in a basket or wicker work cylinder, and employ it for carded products. Before operating with the preparatory machines, we must first consider what work we have to do, and dispose of our material according to the special kind of wool to be converted inte yarn. We begin by—

First—Properly lubricating the movable parts of the machine.

Second—Arranging the parchments.

Third—Regulating the intervals.

Fourth—Regulating the weights of the top rollers.

Fifth—Regulating the draught.

All the rollers of these machines are supplied with weights and levers, exerting a certain pressure on the top rollers. The arms of the levers are movable throughout their entire length, and their power may be modified by means of weights."

Dresser.—This name is given to a warping machine on which sizing is applied to the warp, to machines for applying sizing, etc., to fabrics as well as yarns, to some kinds of finishing machinery, and to the men who attend them; also to sizing, etc.

Dressing.—The dressing in many instances is the composition or ingredients used, the manner or means of application, and often only the result or appearance of an operation.

Drying.—When drying was done in the open air or in rooms, the temperature of which never exceeded 100° Fahr., the process was

not of so much moment as now. The machinery in use at the present time is nearly all devised to dry quickly; to a certain extent this is accomplished by rapid circulation of air, but cold air will not carry the moisture as well as hot air; hence, the latter is employed too freely in many cases. If the operators of machines could only comprehend the danger of overheating some materials, no doubt there would be less fault found with the machinery; it is a noteworthy fact that even those who are supposed to know better, pay too little attention to the matter of regulating the heat. With silks and woolens particularly is it necessary to watch closely, not only the temperature, but the condition of the goods before drying. If woolens are too wet, when dried they are stiff, as if starched, if not clean they will come from the drying-machine in a state difficult to rectify, the colors dingy, perhaps cloudy, etc., etc. (See Tenter Bars.)

DYES.—A few of the most common dyes and dyewoods are mentioned in this work, with the hope of awakening here and there a desire to investigate further a line of study that should occupy the designer, manager and dyer during many spare hours. It is only by understanding the nature of ingredients and compounds that they can be used intelligently.

E.

EDGES.—The importance of perfect sides or edges, be the selvage wide or narrow, is seldom fully appreciated by operatives; indeed, even overseers are frequently either ignorant or regardless of the consequences of crooked, short, long, rolling, thick, thin, imperfect or rough sides. Some of the causes are here enumerated: Crooked edges are almost invariably caused by uneven tension on the filling while weaving, either on account of bad or too long bobbins, crooked shuttle spindle, shuttle eye in wrong place, or anything else showing itself by a difference in tension on full and nearly empty bobbins. Uneven yarn will also make crooked edges, but this is easily traced if the goods are examined while wet or by looking through them toward a strong light. Uneven picks, from whatsoever cause, will sometimes produce this trouble. Crooked edges are only the beginning of a worse evil—cockles. Short edges are usually caused by the warper, and may also be done in beaming. Long edges are a difficulty arising from high sides on the warp beam; whip rolls or lathes which give in the middle; worn breast

beam; also by the warp reel when so frail as to sag between the sides and spiders, or by putting waste and bobbins in at the sides on the cloth beams. When all these matters are correct there may still be a difference in the length of the sides from different looms, sometimes on the same piece; this is often owing to uneven picking, or on account of a peculiar lodgment of the shuttles. A very common trouble with looms having a single box on one side and a number on the other. Temples have much to do with the sides, but any trouble from them should be apparent to any careful observer. Rolling edges are caused by a difference in back and face, usually on such goods as are made with warp largely on one side, filling on the other; whichever side shrinks most readily will roll inwards. With woolens, the fuller and gigger suffer most from this trouble, and upon the fuller devolves the duty of sparing others the annoyance which rolling edges prove to be in all subsequent operations. In sewing for the fulling mill, make short stitches; if possible, sew that side out which naturally rolls in; if impossible for the entire process, one-fourth of the time at least, either first or last, will help very much.

Thick and Thin edges are made in the loom; the tension of the filling and the temples must be looked to first.

Imperfect and Rough edges are frequently the result of carelessness and neglect either on the part of the weaver or loom fixer. When the shed is not good at the sides, the time of picking incorrect, or one shuttle delivering loose filling, another tight, look out for imperfect and rough sides, they will certainly show on threadbare goods when finished, if not before.

Electricity.—Electricity has not as yet proved very successful in applications of it to the textile manufacturing processes. Some very ingenious inventions exist; but, for some reason, they do not come forward and into general use. Among these are electricity applied to the Jacquard loom and punching machines, to cutting velvet plush, etc., etc. But electricity, as an annoyance or difficulty, is very common, particularly in factories, where wool is used. This is more especially the case in carding and spinning; weaving in a cold, dry room is also difficult on account of it. Of the many devices employed to prevent troubles from electricity in carding there is perhaps none which can be covered by one word better than "moisture." Moisture in the stock or in the atmosphere is all that is necessary. A little escape of steam in the vicinity of a card giving trouble has remedied the matter, but a better way is to apply it to the stock.

Electricity is almost sure to be troublesome when wool has been exposed to great heat in drying, if an insufficient quantity of oil is used, or if the colors either from excessive use of acid, alkali or heat in boiling, have attacked those properties of the staple which wool requires to convey its true nature to the fabric. There is also much electricity in factories altogether generated by friction. This is especially a serious trouble in the card; and, no doubt, the process of carding does generate some electricity. Condensing rollers or drawing rollers, when set too close, bring about this evil in the very spot where it is the greatest nuisance. There are some ten pages on this subject in the book called "Queries and Replies," taken from the Industrial Record. Like everything else in this book the information is all direct from the workroom and is, therefore, very valuable, as it gives the varying success of different remedies. The electric light is without doubt a grand success in factories. Several hundred of them are already in use, and in one or two instances are used with the best results in shops running night and day.

Emery.—The emery used for grinding cards is of various sizes and qualities. Nos. 3 and 4 are good sizes, and are preferable to finer kinds. It must be perfectly free from rotten or pounded stone and all ingredients not belonging to it. Emery may be tested by laying some of it on a flat piece of iron and attempting to bruise it with a flat-faced hammer; if good and hard, it will resist the hammer; if soft or mixed with any improper matter, it will yield easily, and should be rejected. Coarse emery cuts and grinds quicker than fine, and also sinks in among the points of the teeth, cleans them, and cuts off any roughness, barbs or hooks that may be on them, and prevents them from rubbing on each other. If the emery is too coarse, it causes rings or grooves and ridges around the cylinders. Some carders wash the emery in warm water, when the chips and dust will rise to the surface, and may be washed off; after this the emery must be dried. It can sometimes be sufficiently cleared by sifting.

To cover rollers, have them turned perfectly true, and a sufficient quantity of glue in readiness. The glue must be of a medium consistency; if it is too thick, it will not adhere to or spread evenly on the rollers; it must be applied as quickly as possible, while the roll or cylinder is in motion, particular care being taken not to miss any part, especially the ends, as it is there they first begin to give way. As soon as the roller is covered with glue quickly strew on the emery, letting it fall from a height of two feet to make it stick, and

lay it around the ends of the rollers by hand in order to make it adhere to those places. The rolls should be allowed to dry during the night; the next day receive a second coat, applied as the first except that the glue may be somewhat thinner; they should again be left over night to dry. The next day all the glue and waste emery adhering to the ends should be scraped off, tried with a straight edge, the emery rubbed off the high places, and the whole made as level and true as possible; next apply a wash composed of 2½ ounces of glue and one pint of water; this wash unites all the coats firmly together, and does not prevent the emery from cutting. The rolls should be revolved while this wash is hardening.

Many forms of hand emeries are also employed. To cover them the same principles are involved as in covering rolls. The emery used for grinding shears, etc., etc., is necessarily very fine, and best applied when mixed with a heavy oil to the consistency of lard that will just run.

ENDS.—The ends of warp threads are called ends. The use of the word for threads in general is very common.

ENGLISH AND FRENCH METHODS for spinning worsted yarns are often alluded to. The difference is mainly in the manner of drawing from the sliver to the thread. Leroux has given full descriptions of both methods in his work on the manufacture of worsted yarns. The information he gives should be well understood by all who use or make worsted yarns.

ESTIMATES.—It is often necessary to estimate the probable cost of an intended fabric before proceeding to make it; the calculations necessary are the same as those treated under the head of Calculations and in Yarn Numbers, Reeds, &c. But to make these estimates reliable requires quite as much judgment as mathematical ability; indeed, the latter is useless without the influence of the former.

F.

FABRIC.—The word fabric is very frequently used instead of texture. Webster's definitions of the word are as follows:

1. The structure of anything; the manner in which the parts of anything are united by art and labor; workmanship; texture; make; as cloth of a beautiful *fabric*.

2. That which is fabricated; (*a*) framework, structure, construction, edifice, building. (*b*) Manufactured cloth. "Silks and other fine fabrics of the East."—*Henry*.

An effort has been made to use the words fabric and texture independently of each other in this work, as a combined use of them is often confusing to the beginner. There is hardly an exception to the rule in this book—fabric being used for "manufactured cloth;" texture, for the structure or construction of the fabric.

FALLERS.—On some drawing frames the gills are propelled by a screw; when they reach the end of the screw they fall into another which carries them back to the other end again. This falling gives these several bars carrying the gills this name.

FANCY.—The cylinder on a card which raises the stock from the main cylinder, that the doffer may take it. The wire should be long, set and bent very regularly and accurately, since the fancy should not be ground much. If the fancy wire is soft it will soon lay down irregularly and always after prove a nuisance.

FANCY DIAGONALS.—Some English writers seldom use the word diagonal, and would therefore head this paragraph with Fancy Twills. Whatever they call it, the English writers and weavers understand the application and variation of twills thoroughly, as may be seen by the several quotations under the head of twills. Fancy diagonals are nothing more or less than very large patterns of the same family of textures as twills, but the long floats are frequently tied down in a manner to produce fancy effects.

FEEDERS.—The employees, the machines or parts of machines which feed or enter stock of any kind, to the machinery. On wool washing-machines the feeder is a boy or man who lays the wool on an apron which is in constant motion toward the bath, into which it finally drops the wool. On wool, cotton and other pickers the stock is still fed by hand. On cotton cards the matter of feeding is very simple because the stock comes to the card in laps, but to woolen cards the stock is brought in a loose open state from the picker. Many woolen cards are still fed by hand, but very perfect machinery is now being largely introduced to do the work cheaper and better.

FELT OR FELT CLOTH.—These goods are made by applying heat, moisture and friction to webs of various kinds of animal fibers. The stock is mixed and picked for the cards; carded; from the card it goes to the felting machinery in an open but web-like state; from the felting machine some kinds are taken to the fulling mills, and some kinds of goods undergo various other processes to produce the requisite density and characteristics. The colors and

finish applied are also many in kind, according to the ultimate purpose of the goods.

Fibers, or Fibres.—The fibers used in the manufacture of textile fabrics are described as follows, by Gesner: "The material used in textile fabrics may be animal, mineral or vegetable. The most common are wool, silk, cotton, hemp, flax. Properly classified, they appear in the order below:

A.—*Vegetable.* (1) Fibers from the Stems of Plants.

(*a*) Chinese Grass or Nettle (*Urtica, Nivia,*) is a perennial plant, the stem of which bears broad, oval leaves; the upper side is smooth and of a beautiful green color, while the lower side is covered by a white woolly down. The plant grows in East India, Siam, Cochin China, Japan, China, and on many of the islands of the Indian Archipelago. In its wild state it is called Rhea, and is usually found in almost impenetrable masses or thickets. The fiber of the cultivated plant has a length of 120 millimeters, and possesses a wonderful strength, (some tests having shown a strength two or three times as great as that of Russian hemp.)

(*b.*) Rammèe is a sort of nettle thriving best upon several islands of the Indian Archipelago, where it grows to a height of one to two meters. It is of a yellowish white color, about as fine as a fair quality of flax, lusterless and very stiff.

(*c.*) Jute is a native of China and East India, but successfully cultivated in other parts. It yields a brownish, coarse, long fiber, used largely in the manufacture of twine, burlap, etc., etc. The fiber may be improved by the hackle and other manipulations until a fine lustre is attained, but is always very brittle.

(*d.*) Nettle. Several plants of this species yield useful fibers.

(2.) Fibers from the leaves of plants.

(*a.*) The New Zealand Flax (*Phormium Tenax*). This plant, native of New Zealand, produces a leaf from $\frac{1}{2}$ to $1\frac{1}{10}$ meters long and 1 to 3 ctm. wide, which contains great numbers of fibers from 5 to 11 millimeters long. This material resembles hemp, but is not so soft and flexible, although producing very durable fabrics.

(*b.*) Manila or Manila Hemp (*Abaca*) is more extensively used for ropes than fabrics, but does occasionally enter into various kinds of the latter.

(*c.*) Ananas Hemp (*Bromelia Ananas*) comes from the West Indies and South America. The fibers of the roots are long and

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tough, furnishing a material with which the Indians produce a sort of coarse linen.

(3.) Fibers from Shells or Husks:

(*a.*) The Cocoa fibers possess remarkable elasticity and strength, and are used for carpets, mats and various kinds of plaited goods.

(*b.*) Of the many other vegetable substances that may be woven. Wood, straw, etc., etc., are probably the most common.

B.—*Animal Fibers.* (*a.*) Cashmere or Kashmere Wool is the fine wool-like hair of the goat (*Capra Hircus*, *Varietas Lanigra*). This goat thrives best upon the Himmaleh mountains at an altitude of 5,000 meters. The higher the altitude, the finer, softer and thicker the coat of hair is found to be. Nearly all of this staple is manufactured into shawls in Cashmere. What little is sent to other markets may be said to be of three kinds or colors—white, grey and brown. The word cashmere is also used to designate certain fabrics made of wool or silk warp and goat hair, or fine merino wool filling. Cashmere Satin (woolen satin) is a smooth, lustrous fabric, the warp and filling of which are of combed wool or worsted. Cashmere Muslin, (wool muslin, mousseline-laine); the warp and filling of this fabric have little twist and are woven very loose. In Mousselin-deim-laine the warp is cotton, the filling combed wool or worsted. Cashmeret is a fabric more like cloth in its manufacture and appearance. The warp of the best kinds is of a peculiar floss silk, woolen filling. These fabrics are fulled, gigged and shorn.

(*b.*) Vigogue wool is a sort of curly hair from a peculiar sheep to be found in the mountains of Peru, Chili and Mexico.

(*c.*) Alpaca wool is the downy hair of a goat in Peru, is very fine and comes to market brown, black and white. (Alpagnapaco.)

(*d.*) Mohair is procured from the Angora goat of Asia Minor. This staple is largely spun from carded stock, and used as filling for several fabrics, which by fulling, etc., readily yield a nap resembling plush.

(*e.*) Camel hair is the downy hair of certain camels; is used for combed and carded yarns.

(*f.*) Cow hair is spun into coarse yarns, woven into carpets and other coarse fabrics. (Seldom spun alone, but is carried by a more suitable fiber like wool, etc.—Ed.)

(*g.*) Horse hair, dog hair and even human hair finds its way into various textures.

C.—*Mineral Fibers.* (*a.*) Metallic wire is woven for sieves, and

sometimes is introduced into fabrics to represent gold and silver threads.

(*b.*) Gold and silver threads are frequently woven in as ornaments or fancy effects.

(*c.*) Glass threads are now produced and used but for little else than millinery goods.

Figured Weaving.—Is practised as a handicraft process, or the weaver is assisted by the aid of machines. The process of ornamental weavings as used at the present time in India, is perhaps the same as it has been practised there from the most remote times. It consists in interlacing differently colored threads of various substances and thickness; and this is done by inserting them in the warp as in plain weaving. By this means the effect is produced by the different colors and materials, rather than by the ornamental decussations of the threads, in which the skill of the weaver is shown. When assisted by mechanical contrivances the art at once assumes a new feature, for by this means, with only one or two colors or varieties of thread, endless effects can be produced on the surface of the cloth. (Barlow.)

Filling or Weft.—Filling is a word which in textile terms is used for the yarn which fills the warp. This passive and active distinction between the warp and the yarn which is combined with it to make a fabric probably arises from the fact that the warp is opened by the harness motion, the filling being passed through and left in these successive openings. The filling is quite as important, often more so than the warp; yet because it is not subjected to so much wear and strain in weaving, it is often made of stock too poor to produce the desired effect, or to endure the subsequent processes, all of which are more trying to the filling than the warp. This is only another evidence that it will not do to slight anything in preparing the work for a fabric. Several other allusions are made to the important part of filling under different headings.

Fines.—Fines are instituted to aid overseers to enforce rules without discharging, but it is demoralizing to fine so much or so injudiciously as to impress the operatives with a wrong idea of the motive. Frequent and heavy fines are better avoided then imposed, the only true way to avoid them is to discharge the culprit.

Flavine.—This is a coloring matter that has superseded quercitron bark and fustic in dyeing oranges, scarlets and yellows

The quantity of coloring matter is greater than that of quercitron or fustic, one pound of flavine being equal to ten pounds of bark or thirty pounds of fustic. The best mordant for flavine is alum, tartar and nitro-muriate of tin. A solution of flavine will produce the following reactions with the different metallic salts :

Potash Sulphate of Alumina—a very rich yellow.

Nitro-muriate of Tin—a yellow orange.

Muriate of Tin—a sulphur-colored yellow.

Proto-sulphate of Iron—a deep greenish black.

Acids lighten the color of the solution, and alkalies deepen it, causing it to assume more of a red shade.

FLOCKS.—Woolen stock ground very fine. Those caused by the gigg and shear are distinct from those cut or ground purposely. Flocks are used principally to increase the weight and firmness of woolen goods ; when so used they are applied in the fulling mill, that the short particles of stock may penetrate into the fabric and be in a measure fastened there by the shrinkage of the goods. Flocks made of old rags have but little of the requisite properties left, and are not cheap at any price. The rags are often colored to make the flocks appear like new stock, but the microscope will aid any one, after a little practice, to discover this deception. Caustic Potash may be used to discover vegetable substances, which are a dead loss in flocks. The method is to boil a small quantity of flocks previously weighed in a liquor made of one gill of water and a piece of the caustic potash about the size of a common bean, this will dissolve the animal fibers and leave the vegetable, which should be washed out (care being taken to lose none), dried and weighed. Use a glass bowl, sand bath, and spirit lamp. A simple test of the cleanliness of flocks is to spread a small quantity on a sheet of paper or glass, then pass over it or stir with a steel point which has been charged with electricity by brisk rubbing with a clean, very dry woolen cloth. Clean fibers will attach themselves to the point. By re-charging several times the sample of flocks may be robbed of all the perfectly clean fibers. Those loaded with grease or chemically retained moisture will remain. Flocks are sometimes used to fill card clothing on the cards instead of depending upon the leather to sustain the wires in position : a practice now seldom resorted to.

FLYERS.—On spinning frames and twisting machines, the thread guide placed upon the spindle over the bobbin. There are usually two or three eyes or places for the thread to pass through on its way from the rolls to the bobbin or spool. There is no doubt that

the flyer twisters make the most even twist; but as they are slow machines, other devices are more common.

Friction on Warp Beams.—The warp beam should be supplied with means to allow the warp to be delivered at either a given rate of speed or with a constant and even tension upon it. All that can be expected, is to be able to maintain an equal tension, also regulating the friction of the beam that no more strain shall be thrown upon the threads when the beam is nearly empty than when it is full. Upon the tension of the warp while weaving, many fabrics depend for their peculiarities. A fabric that is to be at all elastic should be woven with the warp as loose as possible, at the same time getting in the right number of picks and making a clear shed. A part of the tension of the warp may be regulated by the take-up motion. The two should be worked in relative unison, with due consideration of the effect desired in the fabric, the weight, and the amount of strain the warp yarn will endure.

Fulling.—Fulling is a process applied to certain fabrics composed in part or entirely of animal fibers. It shrinks, thickens and makes the goods more compact. The fibers must be of a peculiar nature or construction to possess the necessary properties which make this result both possible and permanent. This property is found in the fine merino wools in the highest degree. Some hairs have nearly as little of it as vegetable fibers. The nearer a wool approaches hair in nature and construction, the less of the property will it possess. The artificial means employed to produce the result above mentioned are heat, moisture and friction. With these alone it is possible to full some woolen fabrics, but nearly all show better results when some soap is used with the moisture; short staple will not endure the friction produced by the machinery necessary, without soap. The machinery which produces the friction and retains the heat generated by it, and the soap, by means of which the goods are at once moistened and lubricated, are the two principal factors employed.

The machines are considered under the head of Fulling Mills; the kind of soap in its proper place. The application and preparations of the process are alone to be considered here. The application of the soap is an important feature—too much makes the goods clammy; too little, spongy. The soap being too strong will, with the heat of the mill, not only affect colors but the nature of the fibers. It must be gradually and evenly put upon the goods; this is best done by any means which will allow a small stream of

it to be directed upon the goods while in motion. The quantity of soap used must be governed by the time the goods are in the mill, the stock in the goods, and the density of fabric required. When goods composed of short stock (like shoddy) have too little soap in the mill, they will surely chafe, a loss and damage that cannot afterwards be fully repaired. If the soap is not rich enough for the amount of friction and time required, chafing is a sure consequence. If there is much free grease, or dirt, or dye in the goods, the soap must overcome it or be overcome and prove little better than water.

In Rotary Mills of every kind there must be a contrivance to jam the goods together lengthwise, else the goods will not shrink in length, and goods not shrunk in length in the fulling mill, will do so in sponging and in the garment. Almost every one has had experience with goods of this kind, and the consequent annoyances. The contrivance is most commonly applied in the form of a trap box, called "clappers," "crimping-box," "jam," and many other terms by different fullers. The goods running continuously in wrinkles, unless frequently taken out, opened and stretched, will after a while full more in some parts than others, notably those least exposed to the surrounding atmosphere; this is the cause of mill streaks, wrinkles, clouds and rows. There are also other causes for each of these, but when similar effects are caused by uneven appliance of soap, running of colors, excessive grease, dirt, or flocks, or by uneven yarn they are really different, and should not be designated by the above appellations. The time required by fulling can be regulated in part by the frequency of this cooling, opening or stretching, by the amount of cold air admitted into the mill and by the pressure applied.

Opinions vary much in regard to the time required to produce the results, largely due to the fact that different circumstances have been differently observed and accounted for. For instance, two factories may produce the same fabric from the same stock and size of yarn, but one produces the full weight from the loom, in the other, goods from the loom are not up in weight and must be shrunk in length until the weight per yard is right or filled with flocks. It is a great help to the product to weave the goods a little light and gain the weight in the fulling mill, it is true that in reality the loom has to throw about the same number of picks, but the time saved is in the work which goes much better in the loom. To fill cheaper grades of goods with flocks is a common practice, and a little of it on some is a real benefit. The goods to be flocked should have the selvages closely sewed together, with the side to be flocked outside; if not

washed before fulling run dry a few minutes before adding the flocks, a few minutes after, and then wet out with the soap. This makes the goods a little more pliable, gets the flocks more evenly on all parts of the piece before the closing up of the fabric begins. If many flocks are to be put into the goods, fresh flocks should occasionally be added during the process. The slack method of putting in a few baskets full at once and for all has much in it to condemn, principally that the more goods have been fulled the harder they take the flocks; from a lot of flocks put into the mill the goods will take the best first; therefore, after the flocks begin to go in slowly there is only poor flocks left to go in. The practice of mixing good and bad flocks is erroneous. The better way is, to put the desired proportion of the poorer kind into the mill first, and at the right time add good flocks.

The best method to govern the gain of weight per yard by shrinking is given us by a fuller who has had good opportunities to test the rule. Ascertain the weight total of a piece in the grease, after washing, gigging and shearing. Note the difference or loss in each and all these processes. Multiply the number representing the yards in length of the entire piece by the number showing the actual weight per yard in ounces after shearing; divide the product by the weight per yard desired; the quotient is the number of yards in the piece after it has been sufficiently shortened by shrinkage. The difference between this and the length, before shrinkage, shows the length to lose. Whatever proportion of the piece this may be, the same proportion per yard or any number of yards must be taken up. Now by putting two pieces of tape or string in the selvage of the piece any known distance apart it is only necessary to measure this space to ascertain if the proper proportion is taken up. For instance, a piece 36 yards long weighs 18 ounces per yard after washing and shearing; if kept out in length it would weigh say only 16 ounces, but should weigh 18 ounces. It is, therefore, 2 ounces light. To gain 2 ounces per yard, how much must the piece be shrunk? Thirty-six yards clean, weighing 16 ounces per yard, the total weight is $36 \times 16 = 576$ ounces, it will take as many yards of 18 ounces each to make 576 ounces as 18 is contained in that number=32. The piece must be shrunk from 36 yards to 32—a shrinkage of 4 yards, or $\frac{4}{36}$ of the whole. Now, if the whole piece must shrink $\frac{4}{36}$ of its own length, each yard or any number of yards, in any part of the piece, must shrink in the same proportion. To make the calculations easy, measure off as many inches between tapes as there are yards in the piece, then you have only to shrink this marked space

the same number of inches as the number of yards the piece is to be shrunk, viz., in the above example you would measure 36 inches, and this would have to be reduced to 32 inches. It is a good plan to mark two or more places in different parts of the piece. By carefully noting on the first piece how long the felting-box or clapper was applied a safe guide for others of the same kind is obtained. Goods should always be washed as soon after fulling as possible. If they must lay over night let them be well spread out.

Fulling Mills.—The machines for fulling cloth are termed fulling mills. There are many varieties which are very similar; they may be divided into three or more kinds—the fulling stocks or hammers, the broad rotary mills, and the narrow rotary or German mills. The fulling stocks are now almost superseded, not because they are not good, but that the power and time required is greater than in rotary mills of the best patterns. There are some goods, however, that have not yet been fulled just right in anything but stocks. The broad rotaries are so called because the rolls between which the goods pass continuously are long, making the machine so wide as to admit two, three or even four pieces side by side; while this is an advantage in one way, it is quite the contrary in another, for too much space forbids raising the temperature of the atmosphere within it to the proper degree without the introduction of heating apparatus, steam, etc. The rolls in the narrow mills are only wide enough for a single piece. Some have several of these rolls on one shaft side by side. The narrow mills, being a more recent invention, have in many parts improvements on the older kinds. The many builders of these are all making the best. It is safest, therefore, to inquire of those who have given them a trial before investing in them, if the machine must do some particular work just right.

Fustic.—The tree from which this dyestuff is prepared is known by botanists by the name of *Morus Tinctoria*, it grows spontaneously in Brazil and West India Islands, (that from Cuba is the best.) The wood is the color of sulphur, with orange colored veins; it contains two coloring principles, the one resinous and insoluble in water, the other very soluble in water, giving a deep yellow color with a light orange cast to the solution. Fustic requires more boiling than logwood to extract its coloring matter, but not so much as camwood, barwood or sanders.

G.

Ganters.—The beams to support jacquard machines.

Gauze (*See Cross Weaving*.)—There are many kinds of gauze, but all real gauze has at least some of the warp threads crossed. When gauze is made right, it will endure considerable washing without displacement of the threads be it ever so open. Imitations, however, have the threads held in place by a heavy sizing. When washed they are, of course, a shapeless mass.

Gaws.—A Scotch term for thin places in cloth. In some sections the term "thin rows," in others "cheats" are used.

Giggs.—Giggs are used for raising or producing the nap in the process of finishing woolens. Upon the single gigg the cloth passes from a roller at the bottom to one at the top and back again a sufficient number of times to produce the desired result, the fabric being held to or from the teazle cylinder by means of adjustable rolls, about eighteen inches from the cloth rolls and nearly three feet from each other in a perpendicular line. Single giggs are also built in a way to touch the cylinder in more than one place. The double gigg is so called because it has two cylinders; the goods on these may be made to pass back and forth or continuously in one way; in the latter case the gigg is termed "rotary," whether it has one or more cylinders. The principle of adjusting rolls is similarly applied as on single machines. The Cross Giggs are a complicated combination of the other giggs, and the addition of separate motion for drawing nap from the warp, or working sideways also, by means of vibrating slats or bands set with teazles, which run from side to side in alternate order, the first in one direction, the next in the opposite. These machines are so complicated that quite a number stand idle to-day, because no one can be secured to run them successfully; but the principle of drawing nap from the sides is very good, and for some work absolutely necessary. In setting up the machines care must be taken to get all the rolls, cylinders, etc., parallel to each other, otherwise uneven work will be the result, particularly if the goods cannot be reversed several times. For single giggs the manner of putting on the leaders is of no small importance; if very long leaders are used this point is not so serious, but with short leaders the practice of fastening with a few hooks only is bad, as it makes the tension on the width of the goods uneven at the ends. As leaders are constantly wearing at the ends, frequent trimming is a natural consequence, and carelessness in

attaching them will complete the rejection of a leader sooner than when a little pains has been taken. The slats must not be put into the cylinder in such a way as to bring the cross bars of the several slats directly in a line, as this will sometimes cause streaks in the nap. If the cylinder vibrates far enough, this trouble is in a measure overcome, but prevention is better than cure. Teazles are almost universally used on giggs to supply the points with which to penetrate the nap or threads of the fabric. They should be as small as the finish called for will permit; of whatsoever size, *they must be uniform and set even* to do good work, and firm to insure durability. When in use the slats should be dried frequently. To clean slats a brush should be provided; hand cards destroy the teazles.

Gigging.—The process of producing a nap on cloths. To know the amount or kind of gigging necessary to produce any desired finish requires an extensive experience on the part of a close observer. Rules are of little use; sound judgment is everything. The points to be considered and borne in mind throughout the operation, may be given in part; first, the treatment necessary to produce the desired finish; second, will the goods produce the desired finish? third, will the strength of the goods permit it? finally, the stock, twist and texture of the fabric in hand. By frequently reversing the piece in order to gigg both ways a full and soft nap is obtained. To do the work nearly all one way makes the nap lay down and cover the threads better, but it will be correspondingly stiff and harsh, when the hand is drawn against the nap, neither will the nap be so full as when the first mentioned method it adopted. The goods should be cropped both ways before the gigging is completed; this results in a more even nap and aids the gigg in its work by making the penetration of the teazles easier. Cloth which has a backing woven on, especially when of different stock or color from the face fabric, should always be gigged on the back first; this clears the face of many penetrating fibers which would otherwise show. Poor slats, that is, such with badly worn or missing teazles, should not be put into a wet gigg. The presumption that anything is good enough for the wet gigg is erroneous. To get a nap clean and smooth to the very bottom, use slats which are well broken in but not worn out. Poor slats will make a curly nap or mottled surface. When the fabric contains considerable silk it is a good plan to use brush slats; after the piece has been wet out give it a good brushing on the wet gigg, to give the silk a lustre not otherwise

obtainable. Steaming goods on the gigg is sometimes practiced on beavers and like fabrics, but the irregular tension so easily produced by the cheap labor usually employed to run giggs will sometimes cause water marks and other variations in the character of the finish on the same piece, and different pieces will not come out alike.

Gill Box.—After the second carding the wool is carried to the machine known as the gill box. This apparatus brings the fibers of the wool into a condition of parallelism. The wool is first caught by three cylinders, which deliver it to the moving combs. The gills, armed with two rows of pins, approach the drawing roller, and one by one sink into a groove which carries them to a second pair of screws; the sliver, after leaving the drawing roller, is rolled off into a spool. Under some machines a steam pipe distributes steam to the compartments intended to receive the wool in its passage. The wool, passing over the heated parts, becomes smooth, and is drawn out without catching.

Gin.—The cotton gin is a machine for clearing the staple of rubbish. The roller gin has long been in use, but it is so slow, and, being suitable for a few kinds of cotton only, it is being superseded by later inventions, of which the saw gin is one. This machine does little injury to the staple.

Gingham.—Gingham is a plaided or checked cotton fabric suitable for dress goods, etc.

Glauber Salts.—Sulphate of Soda.

Green Vitriol.—Copperas.

Grinding.—The matter of grinding cards or shears is very important; as easily overdone as neglected, and although easy enough to describe, by no means a process to be learned entirely from books.

"In setting the emery rollers to grind the cards, do not set them to bear too hard or too heavy on the wire, for this will heat, soften or break the wire, if it is not very good and tough. The emery rollers should be seven or eight inches in diameter, and always two or three inches wider than the card cylinders, so that they may traverse an inch each way on the cylinder, and not leave any of the wire bare. Traversing is effected by means of a waving pulley, about 5½ inches in diameter; the outer rim or edge of the pulley runs in a slot attached to the stand of the roller; or the traversing is produced by a crooked strap, which, fitting between the rims of the pulley, will

move the emery roller longitudinally and around at the same time. The traverse motion may be also produced by a waving pulley at the emery roller. The emery roller must be kept on the cylinders until they are ground perfectly true, and until the greater portion of the teeth are ground to a point. The perfect rotundity of the cylinder may be ascertained by the sound it produces on the emery roller as it runs; the sight may also be of service in this respect, either when the cylinder is in motion or by stopping it and giving it a careful examination. When the surface of a card cylinder has been sufficiently ground it will have a blackish appearance, while those parts that are not ground enough will appear more or less clear and bright. As long as a considerable quantity of white teeth appear the grinding must be continued. One day will be sufficient to grind up a new card, if the emery is in tolerably good order." —*Baird.*

"All the rollers covered with card clothing are ground, with the exception of the fancy alone. The object of this operation is to equalize the teeth, render the surface of the cards perfectly cylindrical, and to give the necessary sharpness to the teeth. The sharpness of card clothing is more apparent in the finer qualities than in the coarser.

"Grinding is certainly more readily performed when the roller is perfectly cylindrical, the teeth and leathers of the clothing both uniform throughout, and the emery-covered cylinder well rounded. In order to grind either a main cylinder or a doffer, two movable pedestals are placed on the parallel sides of the frame for supporting the grinding roller, on the axle of which is fixed a pulley one-fourth or one-fifth the diameter of the roller itself, so that the grinding roller has four or five times as great a circumference velocity as the pulley.

"To set the grinding roller in motion, a pulley is thrown into gear on the side opposite that of the one intended to drive the roller to be ground. This pulley is driven by that of the drum.

"If, for, instance, a doffer is to be ground, it must be made to revolve slowly, whereas the grinding roller turns very rapidly. This latter roller is then brought towards the doffer very gradually, as there is a greater loss than gain in too much haste. If we approximate the rollers too closely, the teeth to be sharpened will only break off, so that we had better never hurry the work. The two rollers work in the same direction.

"Among the instruments invented to improve the operations of grinding and straightening the teeth, we must mention that of Mr.

Moriceau, of Mouy. It consists of a grindstone, either of sandstone or emery, driven with a traverse motion. The cards treated by this apparatus are in no way injured, but on the contrary their teeth are better sharpened.

"For grinding the cards of workers and strippers we generally use a turned cast iron cylinder, covered with one or more coats of emery and mounted on a cast iron frame, on which may also be fixed three or four of the small rollers to be ground. These workers and strippers are arranged around the grinding cylinder and the apparatus set in motion, so that several small rollers can be ground at once.

"After being ground in this way, the rollers are subjected to the action of a cloth covered with fine emery powder (canvas emery).

"We can easily make canvass emeries for ourselves by adopting the following plan :

"Dissolve (by the heat of a water bath) in one litre of water—

Isinglass, - - - -	200 grammes,
Good glue, - - - -	100 "

Spread the canvas to be covered on a table, and by means of a brush paint it over with this glue; then sift fine emery powder over the glue thus spread out, equalize the surface with a smooth roller, and after drying, the material will be ready for use.

"This cloth is usually mounted on two quarter circles, bound together by two parallel cross pieces.

"The process of grinding is terminated by exposing the card clothing of the roller, while revolving, to the action of the canvas emery thus mounted, and then giving a last finish by the application of a leather, mounted in the same manner as the canvas emery and smeared with oil and grindstone dust."—*Leroux.*

Shear grinding is quite another matter ; this is done with very fine emery for a time, but after a while the revolver, ledger-blade and rests should be sent to the makers to be trued, or else, what is better, a machine for the purpose should be at hand and used once or twice every year. In the book, "Queries and Replies," already several times referred to, may be found directions for grinding shears, said to be those sent out by a firm of shear-builders. More minute instructions, written expressly for this work by an expert shearer, are here given, partly because on some points he takes issue with the above, on others he is more explicit. In preparation for grinding, back off the ledger so far that a light wrapping paper may be drawn between the blade and revolver. Next ascertain the relative position of the revolver and blade ; this is most accurately done by use

of a try square and straight edge. Place the angle of the square upon the centre mark made on the boxes of the revolver by the makers. Lay the straight-edge on the ledger-blade letting the end project to meet the square. The revolver will doubtless be found too high; if so, drop it to its proper place, when there, about $\frac{1}{16}$ inch of the square should be visible under the straight-edge. Some advise setting up the blade instead, but this will not be of much use if the blade is properly set. (It should not be under the revolver too much.) By dropping the revolver further, a deeper concave may be made. This is not desirable, because it will not retain sharp edges so long. Let up the blade to within the thickness of tissue paper. Next, cover the brushes and rest to protect them from oil and emery. Put the belt on to reverse the revolver. Having mixed flour of emery and oil to the consistency of cream, apply it with a large paint brush. The advantages of a brush over those of a strap are obvious to any thinking mind. While applying the emery set the blade closer from time to time but only a very little at a time. When the grinding is completed polish the ground surface by thinning the emery with oil, then follow with clear oil, or a little oil and plumbago. The revolver should next be taken out, everything well cleaned and the ledger blade honed to turn the edge toward the bevel. Never hone enough to make a bevel on the face. Now, let the blade down to the rest to make sure that they correspond in setting; replace the revolver and give it a few turns to cut off the rough edge which was turned over by honing. If the grinding has been successfully accomplished it should now cut tissue paper smooth in all parts without further setting. If this test proves all correct, it is not well to alter the relative position of the blade and revolver until it is necessary to grind again. To bring the edges closer together raise the revolver a trifle.

Grist.—A Scotch term for the size of a sliver, slubbing, roving or yarn.

Ground or Ground-work.—The plain texture surrounding the fancy effects in fancy or figured cloth.

Guipure.—This word is sometimes used to designate some kinds of lace, again for pointed lace or lacework in general.

H.

Hackel or Hatchel.—A comb-like device for straightening and separating flax, &c. A sort of hackel was employed when wool

was combed by hand. In some parts gills are still called hackels, and fallers hackel bars.

Hair Cloth.—The original hair cloth was no doubt that at one time made because woolen goods were not allowed in the Temple. The goods now known in the trade as hair cloth are of such material as to fit them for no other use than furniture coverings and the like.

Hair Lines.—Hair line fabrics are those in which the color and texture are so combined as to produce a fine line. The following Hair Line Drafts will serve the beginner well in making experiments. It is an easy matter to vary the yarn colors and arrangement without violating the principle of hair line weaving.

HAIR LINE DRAFTS.

A

Warp Draft.

1 Mix
1 Black
—
2 threads per pattern.

Drawing-In Draft.

```
1
 2
```

Filling Draft.

1 Mix
1 Dark Blue
—
2 threads per pattern.

Chain Draft.

```
2□*
1*□
 1 2
```

B

Warp Draft.

2 Mix

2 Black
—
4 threads per pattern.

Drawing-In Draft.

```
1
 2
  3
   4
```

Filling Draft.

2 Mix

2 Black

Chain Draft.

```
4□□**    or   4*□□*    or   4□*□*
3□□**         3□□**         3□□**
2**□□         2□**□         2*□*□
1**□□         1**□□         1**□□
 1 2 3 4       1 2 3 4       1 2 3 4
```

C

Warp Draft.

1 Mix
1 Black
1 Mix
1 Black
1 Mix
1 Black
1 Black
1 Mix
1 Black
1 Mix
1 Black
1 Mix
—
12 threads per pattern.

Drawing-In Draft.

```
1
 2
1
 2
1
 2
1
 2
1
 2
1
 2
```

Filling Draft.		
1 Mix	2□*	
1 Black	1*□	
—	1 2	
2 threads per pattern.		

Chain Draft.	
or 1 Mix..................	12□*
1 Black......	11*□
1 Mix....................	10□*
1 Black................	9*□
1 Mix..................	8□*
2 Black {	7*□
....	6□*
1 Mix..................	5*□
1 Black................	4□*
1 Mix..................	3*□
1 Black	2□*
1 Mix.......	1*□
—	1 2
12 threads per pattern.	

The principle is simply this: To make a hair line lengthwise of the goods, use the same color of filling as that of the warp threads which are down in every shed. To make cross lines, use filling of the same color as that of the warp threads up in each shed. At least two colors in the warp, and two corresponding ones in the filling, also a plain texture to suit, are needed to make a real hair line. The hair lines made with a line in the warp only, the filling being all one color, are not the genuine, but imitations.

By a texture to suit, is meant one which will confine the floats of the warp and filling threads over the respective colors.

The principle of hair lines may be extended to large patterns, but as soon as the fine line is augmented into what may fairly be termed a stripe, the name hair line is no longer applicable.

Hair Looms.—The looms for weaving hair cloth differ from others mainly in the contrivances necessary to fill the goods. Barlow describes some of them very fully.

Harness, Leaf, Wing or Shaft.—The harness, when complete, implies the presence of heddles: without them it is the harness frame or harness rods, &c. The harnesses are attached to the harness or head motion of a loom by means of harness straps, wires or cords, and the jacks.

Heddles.—*Healds, Harness Eyes, Gears or Leash Eyes,* were formerly made of twine, thread, hair, catgut, &c., &c. The wire heddle has superseded all these, except on a few kinds of goods, where the stain of metal and a few other similar peculiarities are objectionable. The glass mail makes a good thread eye, because it is not so quickly worn by the thread as metal. The twine harnesses are still in use; the twine is heavily coated to make it smooth and durable. Wire heddles were quite universally condemned at first by manufacturers of fine goods, because the eye was too large and not always to be depended upon; but the machinery for producing them has been improved and perfected until any shape and size of eye de-

sired can be produced, and so firmly made that no thread can slip into the twist. The convenience of wire heddles needs no comment. In factories making one kind of goods the year around, this is not appreciated, but in others where every warp varies in number of threads, the saving is a large item.

I.

Imitation Furs and Skins.—These goods at times are very popular for cloakings. Of this kind also are many robes and mats. In relation to this subject Ashenhurst says:

" The length of pile is a very important matter, especially if the object is to imitate the skins of animals. The length of pile must be in accordance with the nature of the skin to be imitated. Take, for instance, the sealskin, which is very largely imitated, sometimes by the warp pile principle, and sometimes by the weft pile principle. The pile or nap of a sealskin is of the medium length, from a quarter inch to about half an inch, somewhat longer than an ordinary velvet, while an imitation dog skin of the long curly or wavy kind has a very long pile or nap, ranging up to an inch in length. In both these kinds of skins there are important features to be observed, quite apart from the weaving. Seal skins are very often made with a sort of tan-colored ground, and the tips of the pile are colored a very dark brown, which gradually gradates down towards the ground, thus giving it an exceedingly rich appearance. This tipping, as it is termed, is done after the pile is woven and cut, and is really a part of the finishing process. In the imitation dogskin the curl or waviness is produced by a preparation of the pile warp before weaving. The yarn is crimped, the length of crimp being regulated by the amount of waviness it is desired to give. The crimping is set in the yarn by a steaming process, the yarn is then made into a warp, and woven over wires and cut. The moment it is cut it falls into the crimps again, and thus produces that wavy shagginess. No matter what the effect on the face may be, if the pile is a warp pile the principle of making is the same. If the pile is of a material which is very likely to pull out easily it is more firmly bound into cloth by interweaving, and *vice versa*, but all other effects, such as curliness, waviness, coloring, etc., are produced in the preparation of the yarn before weaving, or in the finishing. Numbers of various effects in imitation skins might be given, all produced by different processes, but the object of this work is to

deal with weaving only, and to lay down the principles so that they may be applied to all classes of trade, and not to detail the manner in which any particular cloth is made, otherwise there might be no limit to the work, and a vast amount of information might be contained in it which would be of no value except to those engaged in that special branch of trade. Weft piles are produced by the material of which the pile or nap consists being thrown in as weft instead of warp. The appearance of a weft pile is usually totally different to that of a warp pile, inasmuch as the warp pile being woven over a wire and cut down, the pile is made all of a length, and unless in the case of a very long pile, or when the yarn has previously undergone a preparation for the purpose of producing some special effect, all warp piles present a smooth even surface, the tips of the pile only being presented to view. But in the weft piles this evenness cannot be well maintained, partly in consequence of the manner in which the pile must be bound into the ground cloth, and partly in consequence of the method of cutting making it almost a matter of impossibility for both sides of the loop to be cut of an equal length. There are one or two exceptions to this which will be mentioned, but they are only in special makes, and have each peculiar characteristics."

India Shawls.—The materials of which the shawls are made is wool called *touz*, procured from a goat of a particular species, frequenting the valley of Cashmere and the neighboring mountains of Thibet. The fur of this goat is of two sorts: the *touz*, which is a soft, woolly undercoat of greyish hair, and an outer coat of long, silken hairs. To make a shawl a yard and a half square requires the *touz* of ten goats. The different parts of it are afterward sewn together with great skill. When busily engaged the artisan can earn at the utmost four annas, or eight cents of our money, per day. India shawls are named Dacca, Delhi, Bombay, Calcutta, Umritzer, &c., after the districts in which they are made. The labor, however, is what chiefly determines the value of a shawl, even when the texture is not the finest.

Indigo.—"This is a vegetable color, and belongs to a leguminous plant found in India, Africa and America, named *Indigo Fera*. There are about sixty species of this genus, and all yield indigo. The species from which it is extracted are the *I. anil*, the *I. argentea*, and the *I. tinctoria*."

"When indigo was first introduced, only a small quantity was

added to the woad, by which the latter was much improved. More was afterwards gradually used, and at last the quantity became so large that the small admixture of woad served only to revive the fermentation of the indigo. Germany thus lost a production by which farmers, merchants and others acquired great riches. In consequence of the sales of woad being so much injured, a prohibition was issued against the use of indigo in Saxony in the year 1650; and in the year 1652, Duke Ernest the Pious caused a proposal to be made to the Diet by his envoy, that indigo should be entirely banished from the empire, and that an exclusive privilege should be granted to those who dyed with woad. This was followed by an imperial prohibition of indigo on the 21st of April, 1654, which was enforced with the greatest severity in his domains. The same was done in France; but in the well-known edict of 1669, in which Calbert separated the fine from the common dyers, it was stated that indigo should be used without woad; and in 1737, dyers were left at liberty to use indigo alone, or to employ a mixture of indigo and woad."—(Barlow's "Manufactures and Machinery of Great Britain.")

"The indigo plant which grows in Bengal is small and straight, with thin branches which spread out in the form of a turf. The average height is about four feet. The leaves are soft, and like those of the common clover, and the blossoms are of a blue purple color, and when the plant is in full blossom it yields the greatest amount of indigo.

For the mode of extracting the indigo from the plant, see Barthollet on the "Elements of Dyeing; Dr. Ure's "Dictionary of the Arts of Manufactures;" and Dr. Thomson's "Vegetable Chemistry."

The impurities in indigo are iron, clay, lime, magnesia and silica of a substance somewhat like gluten.

Each chest you will find to contain a quantity of dust which sometimes amounts to eight or ten pounds. This dust is an adulteration composed of starch or white lead mixed with powdered indigo, and is put in the chest in order to increase its weight.

The principal varieties of indigo in commerce are the Bengal, Guatemala, Madras and the Manilla.

The varieties of the Bengal indigoes are numerous, the best varieties are:

First—The superfine or light blue. This is in a cubical form, light and soft to the touch, of a clean fracture, and will give a beautiful copper color on being scraped with the nail.

Second—Is called superfine with a violet color by being scraped. The thirteenth variety is an ordinary and low copper-colored indigo, with a copper-colored blue or red cast, and hard to break.

The indigoes of Guatemala are of various kinds. The best are a bright blue color and very light and fine. These indigoes are equal to the best Bengal. The inferior kinds are a violet color and as a general thing are more mixed than the Bengal kinds.

The Madras indigoes have a rough fracture. These indigoes when of the best quality, have great lightness, but are not equal to the Bengal or Guatemala. The middling kinds have a very slight copper color. The inferior kinds have a dark or muddy blue, black, or even gray, and greenish color. The Manilla indigoes are of a finer and lighter color than those of Madras, but not so fine as those of Bengal. The middling kinds are of a violet color, but are inferior to the violet of Bengal.

The tests for indigo are too numerous to insert in a book of this kind, besides being too tedious and difficult for most dyers, they not having the facilities to carry out such delicate operations as that of testing indigoes, and for more light upon this subject, dyers must consult, "Dr. Thomson's Vegetable Chemistry," and the other works mentioned in this article.

Ingrain.—This term is particularly applied to certain carpets, and implies that the wool was colored before manufacturing. This it implies, we say, because it is no longer really true of ingrain carpets, they being now largely dyed in the yarn. To all intents and purposes the same, as coloring in the wool as regards the nature of the goods.

Inkle Loom.—A ribbon loom.

Irregular Fabrics.—By irregular fabrics we understand goods which are not a straight piece of cloth; indeed, in some instances they are a garment almost complete, such as underwear, skirts, corsets, etc.

The corset is woven so that the warp encircles the body; hence the top and bottom are the edges of the web as it comes from the loom. The gores required to give necessary shape are therefore on each side of the web, the middle, or waist part, being smallest. The warp is composed of 36 independent sections, so arranged as to play off warp only where filling has been left in the shed, or so far as the shed extended; hence, when a filling thread has been inserted through the entire width of the cloth, they all give warp, but in weaving the gores, where the filling was inserted into but a few

inches of the fabric, only those sections on the corresponding space allow the warp to advance.

To produce the shed in the right place to weave the double cloth for the pockets, and to produce the neat fancy effects of the weaving, requires a Jacquard head, but both this and the sectional let-off motion, though perfect in operation, would result in shapeless goods, and prove uncontrollable, if the ingeniuous take-up motion here applied were not used. This consists, first, of a wooden bar inset with points so as to retain all that is fed to it. Whatever portion of the web has been filled by any pick is slackened by the next beat of the lathe, and the take-up motion consisting of a rubber apron closely adjusted, draws up such slack, the above mentioned bar retaining all that is drawn, always leaving the web before the reed square, though the amount of cloth woven at the selvages, or top and bottom of the corset, is about double that in the middle.

A very ingenious contrivance for taking up all slack in the filling by the shuttle is employed here, and is indispensable for this work. It would be impossible to do it justice without a diagram. Suffice it, therefore, to say that it not only takes up all the filling necessarily extended at every pick, from the web to the shuttle, at its destination on either side, but also equalizes the tension to perfection. This improvement, added to other shuttles, would, as in this case, obviate great waste or uneven selvages or kinks along the sides of the goods, as is often the case, even in plain goods. It is very evident that with a loom so well adapted to eccentric shapes irregular weaving must have a great field, and there is no reason why other garments, such as hosiery, under-clothing, skirts, etc., should not be as successfully produced.

Italian Cloths.—A cotton warp and worsted filling lining cloth. Most of these goods are piece dyed.

J.

Jacks.—In the textile interest we have two jacks of importance, beside the many which do not amount to much. The loom jack is a part of the harness motion. Murphy speaks of jacks as a part of the hand looms in his 1831 edition. The spinning jacks are being superseded by genuine mules or by cheaper machines, an imitation of the mule called self-operators.

Jacquards.—Such thorough and finely illustrated descriptions

of these machines may be found in Ure's Dictionary, Ashenhurst's, Barlow's or Gesner's works, that it seems superfluous to repeat them in an abbreviated form here. The later improvements are numerous, each builder having some to present as his special claim to patronage, and each will be liberal in supplying the necessary instructions to accompany them.

JUTE.—A substance resembling hemp, being the fiber of the *corchorus obitorius* used for making gunny cloth; also mats, coarse carpets, etc., etc.

K.

KALEIDOSCOPE.—An instrument very useful to the designers of oil-cloths, carpets, tapestry, etc. When the colors in it are of the right shades, it supplies an endless variety of changes for the same colors, which, with a little modification or correction, will apply well to many textile fabrics.

KENTUCKY JEANS.—A peculiar cotton warp and wool-filling fabric. When made right and honestly, a very serviceable cloth, formerly in color something similar to the cadet and Oxford mixtures, but now made in many variations of color.

KERSEYS.—The common Kersey of to-day is a cheap woolen cloth of a twilled texture from which is derived the name Kersey twill. Simmonds is quoted in the latest editions of Webster's Dictionaries as follows: "A species of coarse woolen cloth, usually ribbed, woven from long wool. [Scot., *Corsage*; D., *Karsai*; Fr., *Carisel*, *Cariset*, *Créseau*; Sp., *Carisea*; Ger., *Kersey*, *Kirsei*; Sw., *Kersing*; Cf. Gael & Ir., *Ceart*, *Ceirt*. A rag, old garment.]

KERSEYMERE.—A woolen cloth of the finest wools—*Cassimere*.

KILOGRAMMETRE.—The weight of one kilogramme raised to the height of one foot in one second of time.

KNICKERBOCKER GOODS.—Are a woolen fabric in part or entirely made of Knickerbocker yarns.

KNICKERBOCKER YARNS.—These yarns are lumpy, spotted or striped, sometimes in several colors, produced in several ways, some of which are described in the following abstract from the Industrial Record, Queries and Replies. "The wool intended for knots is taken from the picker without oiling, and run through the first breaker with the comb idle, and workers and fancy set off accord-

ing to size of knots wanted. The best knots drop between main cylinder and doffer. To make a lot of 500 pounds, red spots in black, first run $12\frac{1}{2}$ pounds of red knots with $37\frac{1}{2}$ pounds of the black wool, through the first breaker, then run through the same card the remaining 450 pounds of black, and in 48 spools for feeding second breaker use 9 of the first lot (knotted spools) and 39 of the black, running the 9 with knots in the top row of creel. To make *silk* spotted Knickerbockers, run equal portions of silk and wool through first breaker, and use only 3 spools at a time on second breaker. Besides setting the workers off from the cylinder, the doffer must be set back—in fact, set clear away from the cylinder. This allows the wool to remain on the cylinder till the naps are rolled, so that they fall away, or rather are flung from the cylinder by centrifugal force. The distance at which the workers are set from the cylinders regulates the size of the naps, but if the doffer be close enough to catch the wool, then you are carding, not napping. If the naps are too hard rolled, they will drop off in the spinning and carding; so they must be left with a beard sticking out to incorporate them thoroughly. Again, if you want the naps all one size, never take wool from the picker to nap, but run it through your first breaker and open it out thoroughly, not partially between the picker and the regular carding or napping."

Knitting.—Knitting is a process of producing a fabric by intertwining the yarn, instead of weaving it together. It is now almost entirely done by machinery. The goods produced are sold as hosiery. It is a distinct and separate branch of textile manufactures.

L.

Lace and Lace Looms is such a complicated subject that space cannot be afforded for the needed illustrations. The subject is well considered by several authors.

Lam.—A heddle or leaf.

Lamps.—Lamps have been almost entirely superseded in factories where gas is available. The lamps to be considered here interest the student more than the manufacturer. Of the many men who will hold important positions in the course of another decade, not a few are obliged to do all their studying by lamp light, in their rooms at home or at the boarding house; a large proportion of

them can get no other time to practice dissecting, &c. To these a lamp which will supply an abundance of light on the work and protect their eyes, is a boon which they cannot fail to appreciate if they will for a moment consider the many men who have ruined their sight for life for the want of a good lamp to study by.

LATHE, LAY OR BATTEN.—The frame in which the reed and shuttle boxes are fastened. Its use on the loom is to supply a raceboard for the shuttles to travel on, and to beat up the picks during the changes of the sheds.

LAYING OUT.—In woolen mills the term laying out is very common; it is more particularly applied to laying out lots, yarns, designs, etc., and refers to the necessary calculations referred to in their respective places.

LEASE, LEA OR LEAS.—By alternately crossing the threads of a warp their regular succession may be retained by means of lease rods or cords. The above terms are used for the cross of threads so made.

LINO OR LINAU.—Murphy describes this as a species of gauze.

LINGOES.—The weights used on the bottom of jacquard leashes. As there is nothing but these weights to draw down the lower sheds upon a jacquard loom, their importance is obvious.

LIVE SPINDLES.—Although now rather too slow, it must be still acknowledged the best for even and smooth work. Live and dead spindles are more particularly known by these names in connection with throstles and cotton spinning.

LOGWOOD.—"The logwood tree is known to botanists by the name of *Hœmatoxylon Compeachianum*. Its bark is thin and smooth, but furnished with thorns; its leaves resemble the laurel. The wood is hard, compact and capable of taking a fine polish. Its specific gravity is higher than water, in which it will sink.

Like many other valuable dyestuffs, logwood was used a long time before the real nature of the coloring principle was known.

"Chevreul made a chemical examination of logwood, and found that it contained a distinct coloring substance, which he called hematine, a name which has been changed to hæmatoxyline, to avoid any confusion with a substance having a similar name, contained in blood."

Logwood contains resin and oil, sulphate of lime and alumina besides the coloring matter. The ingredients vary in different woods, some having more than others.

A solution of this wood is easily changed from its natural color, by alkalies to a purple, by acids to an orange. Almost all the metallic and earthy salts cause abundant precipitates or lakes, with its solutions, the colors of which vary from violet to black, and in all cases retaining a tinge of the violet hue ; so that a solution of logwood always throws down a compound color, whose proportions of red and blue vary with the different metals used, and each gives deeper shades, according as it is more or less oxidized.

Tin alone, of all the metals, gives it the property of resisting acids, and by taking a proper course with a mordant of tin, you can obtain a purple as durable as indigo blue. Alum always gives violet-colored shades.

Logwood enters into all colors that have any tinge of the violet in their composition, such as drabs, lead, slates and all the violet shades, plums, some dark browns, etc. ; but its principal consumption is in logwood blues and in blacks, to which it communicates a softness and glossy lustre, unequalled by any other material.

If a well saturated decoction of logwood be evaporated, a deep plum-colored magma, of a very tough and tenacious consistency, is obtained : this is called extract of logwood, hematine, or hæmatoxyline. Chevreul's process for obtaining the extract of logwood is to digest logwood chips in water at 120° or 180° Fahrenheit, afterwards filtering the liquor and evaporating to dryness. What remains is put into alcohol for a day ; this is again filtered, and the clear liquor evaporated until it becomes thick. To this is added a little water, and evaporated anew. It is then left to itself, and the coloring matter crystallizes.

The extract possesses the same properties as the decoction, and is in comparative strength to good logwood chips as 1 is to 5 : that is, one pound of the extract is equal to five pounds of the chips.

Logwood grows in the West Indies and on the eastern shores of the Bay of Campeachy ; that which comes from Campeachy is the best."—*Gibson*.

LOOMS.—There are now so many kinds of looms that several of the many builders require large books to furnish all the particulars of their manufacture alone. How useless then would be the attempt to describe them all briefly. For a general account of the construction of the more common looms most builders may be depended upon. For the construction of the Jacquard lace loom, etc., etc., the reader is referred to standard works on Weaving, Barlow, Ashenhurst, Gesner, &c., &c. Some of the most common

names may be profitably enumerated: Roller, cam, tappet, chain, draw, open shed, close shed, positive shuttle motion, ribbon and tape looms.

The roller loom proper is so called because the harnesses are raised and lowered by means of straps passing over rollers which are worked by an eccentric motion.

A cam loom, tappet loom and chain looms are so called because the harness motions are governed either by cams, tappets or pattern chains.

The open shed and close shed looms are names used to designate looms which close the shed at every pick, be the next shed entire or in part the same; and those which do not change the position of the harness until the change is called for of necessity by a different shed. Much is said in favor of both which is true, and nearly as much which is exaggerated. There is no doubt that the open shed loom is easiest upon the yarn, but in some textures it makes a rough surface, in others the picks cannot be beaten in fully. The fact is, a loom which can readily be changed from one motion to the other without much trouble is wanted, that the shed may be made as required by the work. Such a loom will doubtless soon be produced in a high state of perfection at the Crompton Loom Works.

M.

MADDER.—" This plant or shrub, *Rubia Tinctorum*, rivals indigo as a dye drug, both from the beauty and permanence of the colors given by it, and also from the numerous shades that can be dyed by it. Madder is raised or cultivated in France, Holland, but mostly in Holland and the Levant. The Levant or Turkish madder is the best. In France and Holland the roots are gathered every three years, in Smyrna and Cyprus they are gathered every five years. When the roots are taken from the ground they are carefully cleansed and spread on the ground to dry; it is then ground to a fine powder and put into casks; in this state it is received by the dyer. Madder should be kept in a dry place, as it easily absorbs moisture which is an injury to it; when kept dry it improves by age, its age can be ascertained by the appearance of the head of the cask, if it is two or more years old the head will be swelled out by the swelling or growing of the madder. The quality of madder is judged by the taste and smell, the good will have a heavy sweet smell, with an earthy flavor, its taste is a sweet bitter; when exposed to moisture its color will pass from the orange tint to a deep

red. Madder is sometimes adulterated with brick dust, red or yellow ochres, sand, clay, sawdust from mahogany, powdered logwood, and sandal wood, etc. The mineral impurities may be detected by putting some of the madder in a glass jar and pouring boiling water upon it, the madder will float and the sand, brick dust, clay, etc., will sink to the bottom."—*Gibson.*

MAILS.—Mails, glass or metal, are thread eyes used on jacquards, and sometimes harnesses. Some glass eyes or mails have also been shown of late in wire heddles.

MATHEMATICAL INSTRUMENTS.—How to use these instruments may be learned from much more satisfactory works than a paragraph in this or any other book. Especially do we recommend the beginner to purchase one of standard authority. The selection of instruments in purchasing, is very practically treated in the introduction of such a work by F. E. Hulmer, F. L. S.

MEASURING.—Measuring in whatsoever part of the factory or processes, should at all times be done with the greatest care and accuracy. The little allowances here and there often lead to greater errors. Measuring machines, wherever they can be applied, if right good, are always better than hand measuring.

MELTONS.—Woolen cloth that has been well fulled, but not gigged. As the nap on these goods is developed entirely in the fulling mill, and because meltons are very generally made into garments with raw edge seams, it is highly important that the stock be short, fine, sound, (of good fulling quality,) that the yarns be fine, not too hard, the texture not too open, and the fulling process just right.

MERINOS.—Many fabrics have from time to time been given this name, sometimes honestly; more often to deceive the trade, by falsely implying that they were made of Spanish or merino wool.

MICROSCOPE.—The microscope is an optical instrument, which should have more than a simple definition here. But so important has its use become that some standard treatise on the subject is more advisable than a brief abstract. Its use in the designing room, however, is a subject which calls for some consideration. It is only of late years that the more advanced designers of textile fabrics have discovered the great aid they may obtain from optical instruments. The old saying, "Don't use glasses as long as you can see better without them," seems to have been interpreted as a general warning against optical aid. The fact that few can see well

without some practice with any instrument, has perhaps led many to think they could still see better without. The microscope, when used properly, is a great help to any designer, those with the very healthiest eyes not excepted. When the proper power is applied in the right place, when the instrument suits the work, and the operator has learned the necessary points in regard to adjustment, etc., there will never more be a doubt of the benefits afforded by the use of optical instruments. Another reason why many have been discouraged in attempts to use instruments, even after impaired sight was cause enough to resort to them, has been the impossibility to get the right instruments convenient in shape and power for the work. Another difficulty has been the ignorance of optics among those who should make the science a study. The compound microscope supplies a field of suggestions to the Jacquard designer which he can fill in no other way. With it he may see the most wonderful arrangement of particles in substances of every kind; it opens to him the endless book of designs which excel all human possibilities, but afford unlimited numbers of suggestions which are more graceful, more pleasing to the eye than those from any other source. As an instance, we would cite a sectional view of many kinds of hair. Almost invisible to the naked eye, under the microscope they are most magnificent designs in gauze. But its use is not confined to suggestions alone. After having become familiar with its powers, one may distinguish the different textile fibers quickly and with a certainty. One may count the fibers in a thread, thus get at the grade of stock and yarn; also ascertain the exact proportion of mixtures. Indeed, there is not room in all this book to tell of all its uses and benefits to manufacturers. The single microscope is no less important because it costs less money; indeed, for some work it is infinitely superior to any compound microscope. Take, for instance, the most common use for it, dissecting the texture. If strong, a mingling of fibers is the consequence; one is confused rather than aided; but with a power that is adapted to the work, one can see every thread clear and distinct; can work for hours without unusual fatigue to the eyes, notwithstanding the threads do not look like so much cord wood, as some expect to see it if they venture five dollars on a magnifying glass. The principal necessity is that of having the instruments constructed to suit the work. This opticians could do if they understood the work, but the time required they cannot spare to learn it. Consequently a good instrument from a good manufacturer may need reconstruction before it

is right for the use of the textile interest. Full instructions for the care and management should accompany each instrument.

Mixing.—When mixing different qualities, to produce mixtures of materials, if the several kinds go into the works at hap-hazard trouble will ensue. When cotton is mixed with wool, the mixing should be done after the wool has been oiled, if oiled at all. When waste or other short fibers are mixed with longer staples, the mixing before the picker is not enough, it will fall unevenly mixed in coming out of the picker; the lighter fibers will not fly like the heavier, or a solid lock like one more open. For fancy mixtures the mixing should not end with picking; the cards must be adjusted to do their share of the work also. When long and short stock are mixed, the two doffers must be adjusted to take stock evenly, or one may take long stock and the other short. In fact, mixing stock is quite a scientific process. To mix colors to produce certain shades is an easy matter for a designer who is properly fitted out and understands the harmony of colors.

Mixtures.—Mixtures of textures are several textures combined or compounded rather irregularly; (not a proper term, but quite common in some districts.) By mixed fabrics, we mean those in which the materials used are several distinct kinds, as cotton warp and wool filling, silk warp and worsted filling, etc., etc.; sometimes, also, fabrics into which inferior stock has been mixed to deceive the purchaser. Mixtures of the stock are common for various purposes. Better stock may be mixed with a lower grade to make it spin to the desired number, the latter may be used in this way to cheapen the goods, or to give the necessary peculiarities to the yarn or fabric. Again stock of several colors may be mixed to produce what is known by the names mixture, mixes and mixings, in different parts. These kinds of mixtures are confined almost altogether to woolens. They are used alone, in combination with each other, and with other colors. There are certain mixtures like the Cadet, Oxford, etc., etc., which are supposed to be made nearly alike at all times and all places, but this is not the case. There is a great deviation of percentage, or shade, from any one sample one may take as a standard. To reproduce mixtures it is necessary to examine the fibers of a sample and count them (this is only possible with the microscope); by this means an accurate estimate may be formed of the colors, quantity and proportions needed. Much depends upon a good combination of colors; if the necessary colors do not combine right, it is well to put in a small percentage of a color which will make up the defect. A black to be mixed

with white should be a blue black, if not, a small percentage of blue should be added to give the blue tone. A blueish red looks well in black, but it must be quite blue to look even decent in a brown. A small percentage of orange in a dark blue blends well.

MOHAIR.—"The silvery fleece." *Mohair* (Angora fleece) is *not a substitute for sheep's wool*, but occupies its own place among the textile fabrics. It has the aspect, feel and luster of silk without its suppleness. It differs materially from wool in the want of the felting quality, so that the stuffs made of it have the fibers distinctly separated and are always brilliant. They do not retain dust or spots, and are thus particularly valuable for furniture goods. The fibre is dyed with great facility, and is the only textile fibre that takes equally the dyes destined for all its tissues. On account of the stiffness of the fibre it is rarely woven alone; that is, when used for filling, the warp is usually of cotton, silk or wool, and the reverse. It is not desired for its softness in addition to silkiness—such qualities as are found in Cashmere and Mauchamps wool—but for the elasticity, luster and durability of the fibre, with sufficient fineness to enable it to be spun. Those who remember the fashions of thirty or forty years ago, may call to mind the camlets so extensively used for cloaks and other outer garments, and will doubtless remember that some were distinguished for their peculiar luster and durability, which was generally attributed to the presence of silk in the tissue. These camlets were woven from mohair. Its luster and durability peculiarly fit this material for the manufacture of braids, buttons and binding, which greatly outwear those of silk and wool. The qualities of luster and elasticity peculiarly fit mohair for its chief use, the manufacture of Utrecht velvets commonly called furniture plush, the finest qualities of which are composed principally of mohair, the pile being formed of mohair warps, which are cut in the same manner as silk warps in velvets. Upon passing the finger lightly over the surface of the best mohair plushes, the rigidity and elasticity of the fibre will be distinctly perceived. The fiber springs back to its original uprightness when any pressure is removed. The best mohair plushes are almost indestructible. They have been in constant use on certain railroads in this country for twenty years without wearing out. They are now sought by all the best railroads in the country as the most enduring of all coverings—an unconscious tribute to the remarkable qualities of this fibre. Mohair yarn is employed largely in Paris, Nismes and Lyons, and in Germany, for the manufacture of laces, which are substituted

for the silk face fabrics of Valenciennes and Chantilly. The shawls frequently spoken of as made of Angora wool are of a lace texture, and do not correspond to the Cashmere or Indian shawls. The shawls known as Llama are made of mohair. One of these, valued at $80, weighed only two and one-third ounces. Mohair is largely consumed at Bradford, England, in the fabrication of light, summer dress goods. These goods are distinguished by their lustre and by the rigidity of the fabric. Mohair is now extensively used to form the pile of certain styles of plushes used for ladies' cloakings; also, for the pile of the best fabrics styled Astrakans.—*Hayes.*

Moreens.—A certain fabric with a watered finish.

Mules.—Mules are without doubt the best machinery available for spinning cotton, wool and worsted, when fine even yarn is the first and great requisite.

Muslin.—Named from Mosul in Asia. There are plain and figured muslins, some nearly as close as cambric, but much finer, yet others almost as open as gauze.

N.

Nap.—The ends of the fibers of which a fabric is composed being drawn out by means of a gigg or napper are called the nap; those worked out on the surface by the fulling process are also called nap, but this nap cannot be made to stand or lay down in such smooth and regular order as when gigged out.

Natural Grease in Wool.—This grease is very variable in different wools as regards quantity, but the nature is similar in all breeds. The soluble part of it is produced by the secretion of the sweat; the insoluble is the product of the soil and surrounding circumstances. Some wools contain from 50 to 75 per cent. of their weight in grease, others only from 15 to 20 per cent. To rid the wool of this grease without attacking the fiber with the chemicals employed, is one of the secrets of success in scouring. The soluble grease is easily saponified, not so with the insoluble, which can be carried off by water only because soluble grease is the agent which retains the insoluble upon and in the wool.

Needles.—There are many kinds of needles used in factories. Beside the large variety of sewing needles, there are those which on some kinds of looms are necessary to convey the pattern from the pattern chains or cards to the lifting parts. Dissecting needles are perhaps the most interesting subject here. They should be as fine

as possible, care being taken to have them strong and long enough for the work and instrument used. They should not have a blunt point like a shawl pin, but taper gradually to the point. At least six kinds of dissecting needles should be conveniently at hand—three or four sizes of round ones, two or three sizes of the flat kinds; of the latter, at least one should have a bend edgewise, to be convenient under a short-focus instrument.

NEUTRAL COLORS.—The effect of these tints and colors are important in textile designs. Ashenhurst says:

"Suppose we have alternate stripes of red and green, or if we have red figures on a green ground, or *vice versa*, the eye could not rest long upon them without experiencing an unpleasant sensation; the two colors would begin to swim into each other, as it were, and the longer the eye rests upon them the stronger and more unpleasant will this swimming sensation become; but if the two colors be separated by black or white, or some tertiary or neutral color, then this swimming sensation will be entirely prevented, and yet perfect harmony will prevail. In the same manner, if blue and orange be juxtaposed the swimming sensation will result, but it may again be prevented by the introduction of neutral. If purple and yellow are placed together the effect is not quite so unpleasant, because the two colors, although complementary, are more nearly allied to light and darkness respectively. Yet even in this case the effect is much improved by the presence of tertiary or neutral colors. Therefore, at all times colors which are complementary to each other should either be present in subdued form or separated from each other by the presence of some neutral color. In addition to this quality of modifying the effect of complementary colors, neutral colors also possess the property of modifying the effect upon each other of colors which possess the same common element. As has been shown, colors which possess the same common element, if placed in juxtaposition, have the effect of detracting from each other, but if separated by black, by white, or by neutral color, this mutual detraction is prevented or modified. If, for example, we place blue and green together, one color will partly destroy the other, and the point of junction of the two will scarcely be discernible, but if we separate the two by either a black or white line we shall find the effect materially improved. In the same manner we may deal with red and orange, or with any other two powerful or bright colors, and the result will invariably be the same. In speaking of neutral colors, the peculiar properties of gold as a

neutral may be pointed out. Although the appearance of the color of gold is decidedly yellow, yet it is one of the most neutral colors to be met with. Not only will it harmonize with any or all colors, but it will modify the effect of any two colors, or compositions of color, upon each other. It is for this property as much as for its peculiar richness that gilded frames are so much preferred for pictures, the richness and neutrality of the color of the gold not only tending to improve the effect of the coloring of the picture, but at the same time effectually preventing the interference in an undue degree of any surrounding colors. Gold is a color which is very rarely used in textile fabrics, yet it may sometimes be used with advantage, and whenever it is used this peculiar property may be borne in mind."

NUMBERS.—A systematic method of numbering everything about a factory that can be numbered to advantage saves much confusion. The method of numbering yarns is given under yarn numbers. A good system of numbering styles is to have two sets of numbers, one to designate the series, another the variation of the series. For example, a pattern is ordered in eight variations. Call this pattern, series No. 1, the several changes, variations, Nos. 1, 2, 3, 4, 5, 6, 7 and 8. The term series may be improved upon, also the word variations. Separate lots of stock laid out for certain orders, the batches colored by the dyer, the warps made by the warper, the cuts by the weaver, and every sample, remnant or other piece of goods finished should be recorded with a series of numbers. The numbering of wool, yarns, etc., is exhaustively treated by Leroux.

NUT GALLS.—Nut galls are an excrescence which grows upon certain species of the oak. (*Quercus infertoria.*) They contain gallic acid and tannin. There are several kinds of nut galls from East India, Smyrna and Aleppo, differing mainly in ripeness of the nuts. Some are black, others green or white. When mixed they are called natural galls. The Blue Aleppo are best for most dyes, the Smyrna come next. They must be ground before they can be used for dyeing.

O.

OIL.—Many kinds of oil are used in and about factories. At one time the varieties were very few, sperm oil for lubricating machinery, olive, poppy or some similar vegetable oil on stock. Mineral oils

are now largely used for lubricating machinery, and are in many respects better than animal oils, although in some few points they are not equal to them. Consequently oils are mixed in different proportions. When well mixed, and according to the work to be done, there is no doubt, the best results can be attained in this way. Of the animal and fish oils used sperm, lard, tallow, red and elaine are the most important, and olive, cotton seed, poppy seed and palm of the vegetable oils. Kerosene and paraffine are the two mineral oils in common use. The following table of comparative weights, clipped from a periodical, is interesting :

	Deg. Baume.	Per Gal.
Naphtha	68 to 73	5¾
Kerosene	45	6½
Paraffine	24	7½
"	27	7⅜
"	30	7¼
"	33	7⅛
"	36	7
Castor	15	7½ to 8½
Linseed, boiled	19	7½
" raw	21	7½
Menhaden, light	20	7½
" dark	21	7½
Cotton seed	11	7½
Whale	21	7½
Fish	22	7½
Olive	22	7⅝
Lard	23	7½
Neatsfoot	23	7½
Palm	25	7½
Sperm, natural	29	7¼
" bleached	29	7¼
Manchester	23½	7¼

" Oiling wool is effected by means of a greasy substance, sufficiently fluid to afford elasticity to the wool. The liquid oils are, therefore, the most suitable, and the more liquid they are the better. Oil possesses the property of rendering the wool supple and adapted to carding, the 'moist' process, on the contrary, destroys the qualities of the wool by the repeated jarring and stretching produced by carding."—*Leroux.*

From 3 to 6 quarts of oil per cwt. of wool seem to be the most common quantities used. Stock to be worked into shoddy must be oiled ; it is found that a good saponified oil is best for this purpose.

Leroux recommends a mixture of oleine and olive oil and gives a good formula for a composition which we do not feel at liberty to publish. The entire subject of oiling is treated in his work and would be well worth the price of the work to some who are sorely in need of advice on this subject.

"Of the elements which analysis shows these oils and greases to consist of, two only may be considered as bearing on their use in woolen manufacture, namely, stearine and oleine, and their value for wool and soap depends largely on the relative proportions of these substances contained in them. The principles which are here suggested as governing their application may be expressed thus:

First—That the successful results obtained in oiling wool will be directly as the oleine in the oil predominates over the stearine.

Second—That the amount of felt or solidity obtained in fulling will be directly as the excess of stearine over oleine in the oil or grease of which the fulling-soap is made.

Third—That the cleanliness of the goods will be directly as the oleine in the oil or grease from which the soap is made is in excess of the stearine.

As to the first proposition, a perfect wool oil must have body enough to protect the barbs or serratures of the fiber and prevent waste, it must be diffusive enough to spread well, and it must scour out of the cloths with ease. Oleine, or so-called elaine, if an honest article could be obtained, would fill these conditions better than any other oil. The next best, when not too costly, is olive (oleine, 72; stearine, 28;) and after it lard oil (oleine, 62; stearine, 38).

As to the second proposition, the value of the different oils and fats for fulling-soaps would be in the following order: Tallow (stearine, 70; oleine, 30); lard (stearine, 38; oleine, 62;) palm (stearine, 31; oleine, 69). In the above enumeration cotton-seed oil is omitted, as its composition and properties have not yet been well enough ascertained to make its use alone in a fulling-soap advisable. It may be used mixed with tallow, for economy's sake, on goods that do not require an extreme felt.

As to the third proposition, the best scouring-soap is that made from oleine. The value of the other oils and greases will be in order reversed from that of their value for fulling-soaps. The reason for this is probably that the oleic acid has not the same affinity for the lime salts in the water as the stearic acid.

The greater the proportion of stearine in the soap the greater will be the liability to decomposition of the soap and formation of in-

soluble stearates in the cloths, and consequent soapy smell. Insoluble, because the best known solvent for them, glycerine, is still too costly for use. The same evil is caused by the use of the stearic oils on wool, because the salts used in dyeing and the iron from card grinding will also form these insoluble compounds with stearic acid.

The above suggestions are the result of efforts to ascertain the causes of the different action of the various oils and soaps in practice. It is not claimed for them that they are indisputable, but the results obtained in an extensive practice based upon them seem to justify the writer in the conclusion that they are in the main correct.—*R. A. Clogher, in a Letter to the Bulletin of National Wool Association.*

Oil Spots on Finished Goods.—Instruct every hand to watch closely for oil spots, and the moment one is detected let every measure to obviate a repetition of the occurrence be attended to; also let the goods be detained in their progress until the existing damage has been rectified; moreover, let no such piece of goods lay in folds, that the oil spots may not come in contact with clean portions of the goods, or, if left in folds, let thick paper be placed between the single folds to prevent multiplication. To extract the oil from cloth, many erroneous methods and ideas are employed, and generally with unsatisfactory results; in consequence, thousands of yards are given away by manufacturers to parties who can easily remove the grease and sell the goods for perfect. The simplest and surest process for extracting oil spots is to saturate the oil spot with benzine, then place two pieces of very soft blotting paper under and two upon it, and press well; in some cases a hot iron is necessary, in others a high pressure, without heat is sufficient. By this means the fat is dissolved and entirely absorbed by the paper. To rub the oil spot with a sponge saturated with turpentine or benzine only spreads the grease.

Organzine.—Silk warp threads, the filling being called tram, from *Trama*, Latin for weft. Organzine is an Italian technical term meaning extra-spun or machined. The organzine silk, commonly used for silk mixtures (cassimeres), is said to have 260,000 to 280,000 yards per pound of 14 ounces.

Orleans Cloth.—Certain thin fabrics, cotton warp, worsted filling.

Overcoatings.—Overcoatings, whether thick or thin, coarse or

fine, should always be an elastic fabric that is as much so as well-fulled woolen goods can be. When hard or "boardy" they never make a graceful garment. The special goods made for overcoats are nearly all soft fabrics. Long nap in fancy effects have been very fashionable, but the cloth finish seems to be reclaiming its former popularity.

P.

Paint for Spool Drums.—Spirits of turpentine, 2 parts; linseed oil (boiled with litharge), 1 part; Venice turpentine, 1 part; Black oil varnish, 1 part.

Paramattas.—Fine cloths originally made of Paramatta wool filling and silk warp.

Pattern.—The word pattern is variously used for design, character and parts of designs, but the use of it in this work has been confined to represent the limits of one complete design in the fabric. Thus, a fancy fabric may be many repetitions of the pattern.

Pattern Books.—Are used in great variety as the best means of preserving samples of cloth, yarn and colors. (See books recommended in outfit catalogue.) A pattern book should open flat and when full be of an equal thickness back and front; the paper should be heavy enough to keep straight and not pucker (pains being taken to place samples of uniform size in exactly the same place on each leaf will permit lighter paper); samples should never be kept in books made of highly colored paper. If the harmony of colors is well understood special colors for peculiar samples may be an advantage, but such book should be made to order and not used at random. Almost any color looks well on manila; many will not look well on pure white. Book paper or natural tint is very good. We advise heavy manila for common use, and white or natural tint for very nice books. It does not pay to buy machine-stitched books; they appear well, are cheaper and do well if not much used, but they lack durability.

Pattern Rooms.—All first-class mills keep one or more looms weaving sample pieces; in nearly every case this work is done in a separate room, often in the designing room. The pattern room should be for nothing else, however, than for producing sample pieces, and for cutting them up into patterns to keep and to send to market. When the pattern room is dispensed with, it is almost

invariably at the expense of interference with regular work elsewhere. Good pattern looms, a large assortment of pattern yarns and many of the conveniences of the designing room are needed. Pattern yarns are not always attainable in the factory in sufficient variety; or novelties in yarn may be wanted which had better be paid for liberally than attempted at the mill. There are a number of reliable houses who furnish yarns of every description. Such an one we consider Messrs. Tingue, House & Co. Many other firms might be mentioned.

Peach Wood.—(See Brazil Wood.)

Pencils.—When sketching for an elaborate design, nearly all grades of artists' pencils are called for; to do more ordinary work the usual five grades of any good make will suffice. When a pencil sketch must afterwards be inked as little erasing as possible should be done, a mark to show that a dot or line should have been erased, often answers the purpose and will disappear when the whole is cleaned of lead. If erasure is necessary three precautions will save bad results: First, a pencil which does not disturb the surface fibers of the paper or make a crease, and will not smut. The smut from some pencil-marks can never be cleaned off the paper entirely; second, use smooth paper with good finish; third, always use clean pure gum. A neat draughtsman or designer will take great pains to keep his rubber clean. To sharpen a pencil cut wood well back then reduce the lead to a point with a pencil file or pad. In this way a clean, long, sharp point is made and no lead wasted by breaking.

Peg Board.—An invention for the convenience of designers in working out small ground fabrics, used instead of a slate or design paper, at one time very common in Scotland. Other devices for the same purpose are now supplied, and are, without doubt, superior to the most improved pegging board. For instance, blocks either cube or thin to cover an equal area each. These may be colored in great variety; thus aid the designer to keep tally of the disposition he wishes to make of several kinds of yarn. The ruled slate, however, has many advantages, especially a double one, which can be closed like a book.

Persian Carpets.—Persian carpets, whether wrought in Persia, India or elsewhere, are formed upon a vertical frame, on which warp threads are arranged. Upon these tufts of woolen yarns are knotted, and over each row of these tufts a wool thread is passed

to bind them. Turkey carpets are made in the same manner, and some French tapestries; only in the latter a shuttle needle is used in attaching the woolen threads to the warp.

Pick.—A throw of the shuttle, also one filling thread, are technically termed a pick.

Pick Counters.—This term is used for a variety of applications. The person who goes about the weave-room counting the picks is, in some mills, honored with this title ; while in others he may have a different appellation, and the instrument he uses for a guage is called pick counter. Some looms have an automatic machine for indicating the number of picks that have been woven during the day ; these devices also have this name. Linen provers are sometimes so called. While on this subject of counting it will be well to suggest that it is better to have a two-inch guage than a quarter inch.

Pickers.—This word is used for various meanings. There are Wool, Cotton, Waste, Rag, Burr Pickers, &c. ; Loom Pickers. Assorters are also called pickers in some districts.

The Wool Picker is a very simple machine, and is used for opening the wool for the cards. It is speeded very high, and the teeth are far apart in order to do the work without tearing the wool.

Cotton Pickers are much more complicated, larger and more expensive.

Burr Pickers are used by woolen mills to extract the burrs from the wool. There are several good machines in the market for this purpose. The chemical process for extracting vegetable substances from the wool is dangerous unless well understood.

Rag and Waste Pickers are machines which convert rags and yarn waste into shoddy.

Loom Pickers are made of rawhide, sole leather, wood, etc., etc. The picker or picking stick, being driven by cams or arms for the purpose, drives the picker and it the shuttle.

Picking Out.—Picking out is a common term for dissecting ; also, when a weaver has to pick back to take out filling on the loom, he is said to be picking out.

Picking Motion.—All the parts of a loom which combined throw the shuttle.

Pirn.—A quill, reed or small shuttle.

Plaiting.—Plaiting was doubtless the beginning of weaving. The remains of this class of weaving have been found in the lakes of Switzerland among the lake dwellings which belong to the stone age.

Poplin.—Poplins proper are made with silk and worsted. Fabrics entirely of worsted are sometimes so named by the trade.

Porcupines.—Some comb circles are called porcupines. The name is also used for coarse gills in some places.

Presses.—Many fabrics must be pressed one or more times during the finishing process. Formerly this was all done with hand-screw presses. Now the hydraulic press is used or the more recent inventions by means of which goods are pressed between a roll and a metallic concave plate, the goods being run through quite rapidly while in the other style of presses they must be folded between layers of press paper, the several pieces built up into a pile in the press with hot plates between them. Here they must remain several hours at least, and often the processes must be repeated. The press papers should be of very good stock, smooth and tough.

Prevention of Knots in Wool.—" In carding there are often found knots in the wool, and the foreman should be aware of the source of this defect, for a material loses much of its value in which it is found to exist to any great extent.

The causes producing knots are :

Too much moisture in the wool.

Irregularities in the surface of card clothing.

Unnecessary coarseness of card clothing.

Dullness of the teeth of the card clothing.

Faulty adjustment of intervals between the rollers ; and especially, the fancy being too far off.

When this case occurs, the fancy is brought nearer the main cylinder, but not too near, however, or by its velocity it will carry away the wool from the surface of the main cylinder.

The fancy ought to lightly touch the wool on the surface of the cards of the main cylinder, so as to smooth, straighten and prepare it to be hooked by the doffer.

The harder and stronger the wool, the more it should be subjected to the action of the fancy ; and, on the other hand, the finer it is, the less it should be so treated. For this reason fancies are made of different sizes, and it may be well to add, that though many machine builders make them, only a few make them properly.

Fancies are sometimes liable to the important defect of carrying off the wool from the main cylinder, and throwing it forcibly into the air. This imperfection is called "spitting," and results either from shortness or stiffness of the teeth, from their being too thickly set, or from the dullness of those of the main cylinder. It may be remedied by slightly flattening the teeth of the fancy, if too stiff, and sharpening those of the main cylinder, when dull.

To obtain a good and advantageous result from carding, we must have:

First—Perfectly oiled wool.

Second—Very little moisture in the wool.

Third—No irregularities in the teeth.

Fourth—Card clothing to suit the nature of the wool.

Fifth—Cards always well ground.

Sixth—A proper adjustment of the intervals, especially in the case of the fancy.

Seventh—The velocity of the doffer regulated to suit the product.

Eighth—The journals of each roller frequently oiled when in motion.

Ninth—A temperature of 18° to 20° Centigrade.

Tenth—Clean belts.

We may add, however, that a temperature of 25° C. would do no harm in carding, but, on the contrary, would enable the wool, which is very elastic when warm, to be more easily drawn out."—*Leroux.*

PRINT CLOTH.—Raw cotton goods woven expressly for prints.

PRINTS.—Cotton goods printed, or calico.

PRINTED DRESS GOODS.—These are made in many ways, but the name was first given to cotton warp and worsted filling goods, or a sort of delaine when printed.

PULLED WOOL OR PELT WOOL.—The wool which is taken from the pelt of slaughtered sheep is known by these names and several others. There are various ways of pulling wool—not exactly of the pulling, but of the manner of loosening the wool in the skin. Several of the chemical processes (notably the lime process) are very much quicker than sweating, but much more unsafe, besides leaving so much lime in the wool as to make it difficult to scour. Even with sweating the healthiest wool is easily injured, and often the damage is not fully developed until the wool has been subjected to scouring or even dye liquors. The purchase of pulled wool then,

is decidedly precarious; even tolerable experts are frequently deceived. When wool has been well handled in pulling, washing and drying, there is no reason why it should be inferior to clipped wool of the same quality and grade, which has been clipped when the sheep would naturally shed much of its wool; the proper time for clipping is a point of importance often forgotten. There is no doubt that wool cut while it still has a firm root in the skin is healthier and stronger than when it has attained its full growth and ripeness, as it were; but the growers dislike to lose four or five weeks' growth, and therefore wait. As sheep are seldom slaughtered at this time, the inference is that pelts in general have "firm wool" on them. The sweating process of pulling is simple but slow. One very successful wool-puller selects the pelts, exposes them on a large field, flesh side up, a few hours on a fair day, then piles them in his storehouse, taking pains to thoroughly salt the flesh side before rolling up each fleece separately. When ready to pull, the pelt is washed and prepared as usual, taken to the sweating pit, allowed to remain there until the wool is beginning to loosen on some pelts; these are then taken out, and the others as fast as they reach the same stage. The pullers next pull the wool, throwing the wool very similar to the manner of wool sorters. If the skin is in good condition the wool pulls freely and without bits of skin coming with the wool. It must be now quickly dried or it will heat, become yellow and tender. It is here that many pullers lose the benefit of great pains in other stages of the processes. Pulled wool containing much lime is much more readily and thoroughly scoured if oiled with some good saponified oil, picked and allowed to lay ten or twelve hours covered up before scouring. The quantity of oil used and the time of laying must be governed by the temperature and condition of the atmosphere at the time and place of its being done, as well as by the amount of lime present in the wool. One to two gallons of oil in double the quantity of water are safe limits to give.

Q.

QUADRILLED.—A foreign term used for "checkered," not common except in trade. Quadrilled design paper is the proper name for counter ruled, like cross section paper. This quadrilled paper, to be accurate, requires much pains and time in preparing the ruling machinery, consequently perfect paper costs far more than

the same quality ruled one way only. Nearly all reliable houses keep only a very good quality of paper, which also enhances the price; they can, however, readily furnish cheaper paper and common cross-ruling to order.

Quercitron Bark.—The inside bark of black oak (*queacus nigra*). It was formerly used, after being ground or bruised, for dyeing yellow, etc., but is superseded by flavine.

Quill.—A weft bobbin.

R.

Raising Machine; *or*, *Raising Engine.*—Scotch and English terms for the machine we call gigg.

Recess.—A crease in a pattern or fabric caused by adjoining threads worked in a manner to produce a sharp depression in the surface.

Receipts.—The many receipts which may be given for compounds and compositions, soaps and dyes, etc., etc., have all a proper place and use, but are really practical only when prepared and used in a practical manner. In other words, only an average formula can be given; variations in stuff used, in the process of preparation, and uses made of the receipts, can not be allowed for; they must be left altogether to the judgment of the operator. Dick's Encyclopedia of Practical Receipts should be in every manager's and overseer's library. Like books, also others quite different yet very valuable, and a host of receipts for dyeing, are extant, all containing many valuable receipts, while not a few are worthless.

Record Books; or, Memorandum Books for Designers, Superintendents, etc., should be of convenient size, good quality paper, plain ruling, and pages numbered. Account books will answer, but the size of book, excepting thickness or number of pages, should be same as the design and sample books. To keep a record of everything one learns, is a trivial task; the benefits afforded thereby may be inestimable. The difficulty some experience in acknowledging new accessions to their stock of knowledge is a serious matter, and no credit to any one. In keeping a record, write concisely, never hastily. The arrangement of the book should be a specimen of systematic habits. It is sometimes necessary to make

a memorandum hastily; have a special book for this, and copy from it at leisure.

Reeds.—Reeds are a series of narrow strips of metal, between which the threads of the warps pass in the loom. The purpose of the reed is two-fold—to keep the threads evenly divided and to strike the filling in many places in beating up. The derivation of the name is from the material used for the narrow strips years ago, viz., split reeds. The writer has a very fine reed of this description still in possession. The origin of the word split, for dent, is also explained by this allusion to the original material used for reed making. The coarser the reed, to a certain extent, the easier the picks go into the fabric. The finer the reed the smoother the goods, and with perfect reeds the less reed marks. Reeds may be unevenly set; the wires may not stand parallel with the warp; the wire may be too thick, thin, wide or narrow for the work in hand; indeed, a perfect reed is not so easily found as needed. The thread in each dent should be such as to be the same in each repeat of the pattern. Threads riding each other may often be remedied by a different number of threads per dent, or by taking different threads of the pattern in the same dent. Some patterns look best with all the threads of the same texture together in the same dents; others are much improved by a different division. Reeds are damaged more by careless handling and abuse than by actual wear and tear necessary. Flat steel wire is now considered the best material for reeds; brass and iron are too soft, and once bent do not spring back into shape and place. Rules for estimating reeds may be found further on, under the head of Rules.

TABLE OF REEDS,

Showing the Threads per Dent, No. of Reed, and Threads per Inch.

Number of Reed.	2 Threads per Dent. Threads per Inch.	3 Threads per Dent. Threads per Inch.	4 Threads per Dent. Threads per Inch.	5 Threads per Dent. Threads per Inch.	6 Threads per Dent. Threads per Inch.	2 and 3 Threads per Dent. Threads per Inch.	3 and 4 Threads per Dent. Threads per Inch.	3 and 5 Threads per Dent. Threads per Inch.	4 and 5 Threads per Dent. Threads per Inch.	5 and 6 Threads per Dent. Threads per Inch.
7	14	21	28	35	42	17.5	24.5	28	31.5	38.5
7.5	15	22.5	30	37.5	45	18.75	26.25	30	33.75	41.25
8	16	24	32	40	48	20	28	32	36	44
8.5	17	25.5	34	42.5	51	21 25	29.75	34	38.25	46.75
9	18	27	36	45	54	22.5	31 5	36	40.5	49.5
9.5	19	28.5	38	47 5	57	23 75	33.25	38	42.75	52.25
10	20	30	40	50	60	25	35	40	45	55
10.5	21	31.5	42	52.5	63	26.25	36 75	42	47.25	57.75
11	22	33	44	55	66	27.5	38.5	44	49.5	60.5
11.5	23	34.5	46	57.5	69	28.75	40.25	46	51.75	63.25
12	24	36	48	60	72	30	42	48	54	66
12.5	25	37 5	50	62.5	75	31.25	43.75	50	56.25	68.75
13	26	39	52	65	78	32 50	45.5	52	58.5	71.5
13.5	27	40.5	54	67.5	81	33.75	47.25	54	60.75	74.25
14	28	42	56	70	84	35	49	56	63	77
14.5	29	43.5	58	72.5	87	36.25	50.75	58	65.25	79.75
15	30	45	60	75	90	37.5	52.5	60	67.5	82.5
15.5	31	46.5	62	77.5	93	38.75	54 25	62	69.75	85.25
16	32	48	64	80	96	40	56	64	72	88
16.5	33	49.5	66	82.5	99	41.25	57.75	66	74.25	90.75
17	34	51	68	85	102	42.5	59.5	68	76.5	93.5
17.5	35	52.5	70	87 5	105	43.75	61 25	70	78.75	96.25
18	36	54	72	90	108	45	63	72	81	99
18.5	37	55.5	74	92 5	111	46.25	64.75	74	83.25	101.75
19	38	57	76	95	114	47.5	66.5	76	85.5	104.5
19.5	39	58.5	78	97.5	117	48.75	68.25	78	87.75	107.25
20	40	60	80	100	120	50	70	80	90	110
20.5	41	61.5	82	102.5	123	51.25	71.75	82	92.25	112.75
21	42	63	84	105	126	52.5	73.5	84	94.5	115.5
21.5	43	64.5	86	107.5	129	53.75	75.25	86	96.75	118.25
22	44	66	88	110	132	55	77	88	99	121
22.5	45	67.5	90	112.5	135	56.25	78.75	90	101.25	123.75
23	46	69	92	115	138	57.5	80.5	92	103.5	126.5
23.5	47	70.5	94	117.5	141	58.75	82.25	94	105.75	129.25
24	48	72	96	120	144	60	84	96	108	132
25	50	75	100	125	150	62.5	87.5	100	112.5	137.5
26	52	78	104	130	156	65	91	104	117	143
27	54	81	108	135	162	67.5	94.5	108	121.5	148.5
28	56	84	112	140	168	70	98	112	126	154
29	58	87	116	145	174	72.5	101.5	116	130.5	159.5
30	60	90	120	150	180	75	105	120	135	165

TABLE SHOWING THE GREATEST POSSIBLE PRODUCT OF A LOOM IN TEN HOURS.

Picks per Inch.	5 Picks per Minute. 3000 Picks in 10 Hours.		10 Picks per Minute. 6000 Picks in 10 Hours.		15 Picks per Minute. 9000 Picks in 10 Hours.		20 Picks per Minute. 12000 Picks in 10 Hours.		25 Picks per Minute. 15000 Picks in 10 Hours.		30 Picks per Minute. 18000 Picks in 10 Hours.		35 Picks per Minute. 21000 Picks in 10 Hours.		40 Picks per Minute. 24000 Picks in 10 Hours.		45 Picks per Minute. 27000 Picks in 10 Hours.		50 Picks per Minute. 30000 Picks in 10 Hours.	
	Yds.	Ins.	Yds.	Ins.	Yds.	Ius.	Yds.	Ins.	Yds.	Ins.	Yds.	Ins.	Yds.	Ins.	Yds.	Ins.	Yds.	Ins.	Yds.	Ins.
5	16	24	33	12	50		66	24	83	12	100		116	24	133	12	150		166	24
10	8	12	16	24	25		33	12	41	24	50		58	12	66	24	75		83	12
15	5	20	11	4	16	24	22	8	27	28	33	12	38	32	44	16	50		55	20
20	4	6	8	12	12	18	16	24	20	30	25		29	6	33	12	37	18	41	24
25	3	12	6	24	10		13	12	16	24	20		23	12	26	24	30		33	12
30	2	28	5	20	8	12	11	4	13	32	16	24	19	16	22	8	25		27	28
35	2	13.7	4	27.4	7	5	9	18.8	11	32.5	14	10	16	24	19	1.6	21	15.3	23	29
40	2	3	4	6	6	9	8	12	10	15	12	18	14	21	16	24	18	27	20	30
45	1	30.6	3	25.3	5	20	7	14.6	9	9.2	11	4	12	34.5	14	29.2	16	24	18	18.6
50	1	24	3	12	5		6	24	8	12	10		11	24	13	12	15		16	24
55	1	19	3	·1	4	19.6	6	2	7	21	9	3 2	10	22	12	4	13	23	15	5.4
60	1	14	2	28	4	6	5	20	6	34	8	12	9	26	11	4	12	18	13	32
65	1	10 1	2	20.3	3	30.4	5	4.5	6	14.7	7	24.8	8	34.9	10	9.2	11	19.3	12	29.5
70	1	6.8	2	13.6	3	20.4	4	27.2	5	34	7	4.8	8	11.6	9	18.4	10	25	11	32.5
75	1	4	2	8	3	12	4	16	5	20	6	24	7	28	8	32	10		11	4
80	1	1.5	2	3	3	4.5	4	6	5	7.5	6	9	7	10.5	8	12	9	13 5	10	15
85	..	35.3	1	34.6	2	33.9	3	33.2	4	32.5	5	31.8	6	31.1	7	30.4	8	29.7	9	29
90	..	33.3	1	30.6	2	27.9	3	25.2	4	22.5	5	19.8	6	17.1	7	14.4	8	11.7	9	9 3
95	..	31.6	1	27.1	2	22.7	3	18.2	4	13 8	5	9.4	6	5	7	0.5	7	32	8	27.8
100	..	30	1	24	2	18	3	12	4	6	5		5	30	6	24	7	18	8	12
105	..	28.5	1	21	2	13.5	3	6	3	34.5	4	27	5	19.5	6	12	7	4.5	7	33.7
110	..	27.3	1	18.6	2	9.9	3	1.2	3	28.5	4	19.8	5	11.1	6	2.4	7	28.7	7	20.7
115	..	26.1	1	16 2	2	6.3	2	32.4	3	22.5	4	12.6	5	2.7	5	28.8	6	18.9	7	8.9
120	..	25	1	14	2	3	2	28	3	17	4	6	4	31	5	20	6	9	6	34
125	..	24	1	12	2		2	24	3	12	4		4	24	5	12	6		6	24
130	..	23.1	1	10.2	1	33.3	2	20.4	3	7.5	3	30.6	4	17.7	5	4.8	5	27.9	6	14.8
135	.	22.2	1	8.4	1	30.6	2	16.8	3	3	3	25.2	4	11.4	4	33.6	5	19.8	6	6.2
140	..	21.4	1	6.8	1	28.2	2	13 6	2	35	3	20.4	4	5.8	4	27.2	5	12.6	5	34.3
145	..	20.7	1	5.4	1	26.1	2	10.8	2	31.5	3	16.2	4	0.9	4	21.6	5	6.3	5	26.9
150	..	20	1	4	1	24	2	8	2	28	3	12	3	32	4	16	5		5	20
155	..	19.4	1	2.8	1	22.2	2	5.6	2	25	3	8.4	3	27.8	4	10.2	4	29.6	5	13.5
160	..	18.8	1	1.6	1	20.4	2	3.2	2	21.8	3	4.8	3	23.6	4	6.4	4	25.2	5	7.5
165	..	18.2	1	0.4	1	18.6	2	0.8	2	19	3	1.2	3	19.4	4	1.6	4	19.8	5	1.8

TABLE SHOWING THE GREATEST POSSIBLE PRODUCT OF A LOOM IN TEN HOURS.

Picks per Inch.	55 Picks per Minute. 33000 Picks in 10 Hours.		60 Picks per Minute. 36000 Picks in 10 Hours.		65 Picks per Minute. 39000 Picks in 10 Hours.		70 Picks per Minute. 42000 Picks in 10 Hours.		75 Picks per Minute. 45000 Picks in 10 Hours.		80 Picks per Minute. 48000 Picks in 10 Hours.		85 Picks per Minute. 51000 Picks in 10 Hours.		90 Picks per Minute. 54000 Picks in 10 Hours.		95 Picks per Minute. 57000 Picks in 10 Hours.		100 Picks per Minute. 60000 Picks in 10 Hours.	
	Yds.	Ins.	Yds.	Ins.	Yds.	Ins.	Yds.	Ins.	Yds.	Ins.	Yds.	Ins.	Yds.	Ins.	Yds.	Ins.	Yds.	Ins.	Yds.	Ins.
5	183	12	200		216	24	233	12	250		266	24	283	12	300		316	24	333	12
10	91	24	100		108	12	116	24	125		133	12	141	24	150		158	12	166	24
15	61	4	66	24	71	8	77	28	83	12	88	32	94	16	100		105	20	111	4
20	45	30	50		54	6	58	12	62	18	66	24	70	30	75		79	6	83	12
25	36	24	40		43	12	46	24	50		53	12	56	24	60		63	12	66	24
30	30	20	33	12	36	4	38	32	41	24	44	16	47	8	50		52	28	55	20
35	26	6.7	28	20.4	30	34	33	12	35	25.5	38	3.2	40	17	42	30.8	45	8.5	47	22.2
40	22	33	25		27	3	29	6	31	9	33	12	35	15	37	18	39	21	41	24
45	20	12.4	22	8	24	2.6	25	33.3	27	28	29	22.6	31	17.3	33	12	35	6.6	37	1.3
50	18	12	20		21	24	23	12	25		26	24	28	12	30		31	24	33	12
55	16	24	18	6.4	19	25	21	8	22	27	24	8.7	25	27.3	27	9.8	28	28.6	30	11
60	15	10	16	24	18	2	19	16	20	30	22	8	23	22	25		26	14	27	28
65	14	3.5	15	13.6	16	23.7	17	33.8	19	7.9	20	18.3	21	28.3	23	2.4	24	12.8	25	23
70	13	3.2	14	10	15	16.8	16	24	17	31	19	1.8	20	8.6	21	15.4	22	22.3	23	29
75	12	8	13	12	14	16	15	20	16	24	17	28	18	32	20		21	4	22	8
80	11	16.5	12	18	13	19.5	14	21	15	22.5	16	24	17	25.5	18	27	19	28.5	20	30
85	10	28.3	11	27.6	12	26.9	13	26.1	14	25.4	15	24.7	16	24	17	23.3	18	22.6	19	21.9
90	10	6.3	11	3.6	12	0.9	12	34.2	13	32	14	29.3	15	26.3	16	24	17	21.3	18	18.6
95	9	23.2	10	18.8	11	14.4	12	10	13	5.7	14	1.3	14	32.8	15	28.4	16	24	17	19.7
100	9	6	10		10	30	11	24	12	18	13	12	14	6	15		15	30	16	24
105	8	25.5	9	18	10	10.5	11	3	11	32.5	12	25	13	17.5	14	10	15	2.5	15	31
110	8	12.3	9	3.6	9	30.9	10	22	11	13.5	12	4.8	12	32.1	13	23.4	14	16.7	15	8
115	7	35.1	8	25.2	9	15.3	10	5.4	10	31.5	11	21.6	12	11.7	13	1.8	13	27.9	14	18
120	7	23	8	12	9	1	9	26	10	15	11	4	11	29	12	18	13	7	13	32
125	7	12	8		8	24	9	12	10		10	24	11	12	12		12	24	13	12
130	7	2.1	7	25.2	8	12.3	8	35.4	9	22.5	10	9.6	10	32.7	11	19.8	12	6.9	12	29.9
135	6	28.2	7	14.4	8	0.6	8	22.8	9	9	9	31.2	10	17.4	11	3.6	11	25.8	12	12
140	6	19.4	7	4.8	7	26.2	8	12	8	33.4	9	18.8	10	4.2	10	25.6	11	11	11	32.4
145	6	11.7	6	32.4	7	17.1	8	1.8	8	22.3	9	7	9	27.7	10	12.4	10	33.1	11	17.8
150	6	4	6	24	7	8	7	28	8	12	8	32	9	16	10		10	20	11	4
155	5	32.4	6	15.8	6	35.2	7	18.6	8	2	8	21.4	9	4.8	9	23.2	10	6.6	10	26
160	5	26.8	6	9.6	6	28.4	7	10.2	7	29	8	11.8	8	30.6	9	13.4	9	32.2	10	15
165	5	20.2	6	2.4	6	20.6	7	2.8	7	21	8	3.2	8	21.4	9	3.6	9	21.8	10	4

REELS.—*Measuring Reels* are used principally by spinners and designers to measure samples of yarn before weighing to ascertain the size number. This machine, although small, is expensive; to be really useful it must be accurate, well made and finished. There are many kinds with registering dials, etc., which add to the cost. A measuring reel for measuring cloth as it comes from the loom was invented not long ago, but the inventor has withheld it for further improvements.

Yarn Reels, for winding the yarn from bobbins, are also used in great variety. Some very complete machines of this kind are made by a firm in Pawtucket, R. I. It is economy to use a good reel; the character of the skein is an important point when it becomes necessary to wind or spool the yarn again. In tieing the parts of skeins together care should be taken to tie with binding yarn that will not break too easily, making knots that will not untie, at the same time tieing loosely that the dyer may easily slip the binding yarn several times while in the kettles (necessary to get some colors even on the skein). The binding yarn used to tie several skeins together should be stronger still and tied more loosely; the dyer must lift this yarn by these ties several times while the yarn is very wet and consequently heavy. It is well to have two distinct kinds of binding yarn for these two purposes. The ends of knots should not be longer than one inch on the binding yarn. When the skeins must be taken apart, it is a loss of time if the binding yarn is so strong that it cannot be readily broken by the operative.

Dye-house Reels are in many instances clumsy, inconvenient contrivances, some driven by hand, others by belts and only here and there as they ought to be by shafting and clutches. A man to turn the reel is very expensive power. The reels should be almost round if goods are injured by bar marks in draining. The writer has seen, in one dye-house, drums two feet in diameter; they were so arranged as to be turned at slow or high speed in either direction by simply throwing in a different clutch. The slow speed was used for winding up and passing the goods through the liquor, the quick motion was applied when the goods were upon the reel after the dyeing process was finished. Before starting the high speed a sort of cap or screen was dropped over the reel; the rapid revolution of the reel extracted the dye liquor in the goods, the screen was so arranged as to keep it from flying about the room and cause it to drip into the kettle.

REPELLANTS.—This class of goods was at one time known as Water-Proof Cloaking. Very few pieces sold as such, however, were water-proof. Cotton warp and woolen filling are the materials used. From 3600 to 5600 threads in the warp and from two-run to seven-run filling are the limits within which the writer has made a large variety of these goods. The size of cotton warp and the texture are varied to suit the demands of the market, varying very much in weight and the amount of cotton to be shown on the face. In using low stock for filling great care must be taken to keep within due bounds, or tender goods will be the result. We give four of the most common textures:

A

4	□	□	□	*
3	□	□	*	□
2	□	*	□	□
1	*	□	□	□
	1	2	3	4

B

4	□	□	□	*
3	□	*	□	□
2	□	□	*	□
1	*	□	□	□
	1	2	3	4

C

5	□	□	□	□	*	
4	□	*	□	□	□	
3	□	□	□	*	□	
2	*	□	□	□	□	
1	□	□	*	□	□	
1	2	3	4	5	6	

D

6	□	□	□	□	□	*
5	□	□	*	□	□	□
4	□	□	□	□	*	□
3	□	*	□	□	□	□
2	□	□	□	*	□	□
1	*	□	□	□	□	□
	1	2	3	4	5	6

As regards the finish of these goods, we would say, full thoroughly, as quickly as possible, without allowing the goods to get very warm; heat and soap permanently fix the stain upon cotton which comes from the colors of the filling. To get a good mill nap some finishers gigg lightly before fulling, but it must be done very evenly and with great care or the goods will be tender. If the cotton must not be very white the goods may be steamed or boiled.

RIBBONS.—"The original meaning of the word ribbon is a long web of silk, worn for ornament or use. Ribbons of linen, worsted, gold or silver thread were formerly included in the term." Ribbon in French is *ruban;* in German and Swedish, *band;* Danish, *baand.* Silk was early wrought into ribbons, and for centuries one web was made at a time; great numbers may now be made at the same time in the same loom. The shuttle of the ribbon loom is not thrown, but is governed by positive motion. It is in this particular method of the shuttle motion and the other necessary arrangements for narrow webs that the loom differs from others.

RIBS—Narrow raised stripes in fabrics are called ribs. Sometimes wide ones also, but the proper application of the term is to small or narrow effects of this kind.

ROVING OR ROPING.—The untwisted strand of fiber ready for the spinning machine. All strands in machinery before that producing roving are called slivers, slubbing, rolls, etc., etc. Some rovings are not twisted at all, while others must have considerable twist.

10

This difference is due altogether to the kind of machinery used, and the variations in amount of twist to the kind and condition of the stock in hand. The size of the roving is almost always larger than the thread to which it is to be spun; the difference is also controlled by the machinery, kind and condition of the staple.

RUBBERS.—The condensing rolls on a card. Rubber springs on many machines. The kinds of rubber needed by the designer are: First, a piece of pure gum; second, some sponge rubber; other kinds for erasing may be added for special work.

RULES.—*Yarn Calculations:* To find the quantity of yarn required for a warp, in runs—

(*a*) Multiply the number of ends by the length in yards and divide by 1600.

EXAMPLE.—3,200 ends × 300 yards = 960,000 yards ÷ 1600 yards = 600 runs.

(*b*) Multiply the number of biers by the length in yards and divide by 40.

EXAMPLE.—80 biers × 300 yards = 24,000 ÷ 40 = 600 runs.

To find the size of a woolen thread when composed of several minor threads—the size numbers of the single threads being known.

(*a*) Divide the product of the size numbers by their sum.

EXAMPLE.—A 2-run and 3-run thread being twisted together, what is the size of the two-fold yarn?

$$2 \times 3 \div 2 + 3 = 6 \div 5 = 1\tfrac{1}{5} \text{ runs.}$$

EXAMPLE.—A 2-run, 4-run and 6-run thread being twisted together, what is the size of the three-fold yarns?

$$2 \times 4 \div 2 + 4 = 8 \div 6 = 1\tfrac{2}{6} \text{ Runs.}$$

$$1\tfrac{2}{6} \times 6 \div 1\tfrac{2}{6} + 6 = 8 \div 7\tfrac{2}{6} = 1\tfrac{1}{11} \text{ Runs.}$$

(*b*) Find the actual weight of the several single threads per yard in grains; divide 7000 by their sum to find the yards per pound. Divide the yards per pound by the number of yards per pound of No. 1 yarn; the quotient will be the correct size.

EXAMPLE.—2-run and 3-run together.

A 2-run thread weighs $\frac{1}{200}$ of an ounce per yard.
" 3 " " " $\frac{1}{300}$ " " "

$\frac{1}{200} + \frac{1}{300} = \frac{5}{6}$ ounce per yard. $7000 \div \frac{5}{6} = 8400$ yards per pound.
$8400 \div 1600 = 5\tfrac{1}{4}$ Runs, or $8400 \div 840 =$ No. 10 (Cotton.)

To ascertain the number of threads in a warp, the number per inch in finished goods being known, multiply the threads per inch by the number representing the finished width in inches.

To ascertain the quantity of each kind of yarn in a warp, the length, number of ends per warp, and the threads in each pattern being known, add the number of threads of each kind of yarn per pattern together; the sum will be the total number of threads per pattern. Divide the total number of ends in warp by the ends per pattern; the quotient will show the number of patterns per warp. Multiply the number of each kind of threads per pattern by the number of patterns per warp; the several products will show the ends of each kind of yarn per warp. Multiply the ends of each kind of yarn per warp by the length of the warp in yards; the several products will show the yards of yarn required of each kind. To ascertain the quantity of filling required for one yard of cloth, multiply the threads or picks per inch by the number of inches representing the width of the goods; the product is the quantity of filling required in yards.*

Reed Calculations.—The threads per warp and threads per inch being known, find the width by dividing the total number of threads by the threads per inch.

The threads per warp and the width being known, find the threads per inch, by dividing the threads per warp by the width in inches.

The threads per inch and width being known, find the total number of threads by multiplying the two known quantities.

When the threads per dent are regular, to find the threads per inch, multiply the threads per dent by the dents per inch.

When the threads per dent vary, find the average number of threads per dent, and proceed as above.

EXAMPLE.—What are the threads per inch when the warp is reeded as follows in a No. 15 Reed:

2, 4, 4, 2, 3, per dent, (making 5 dents per set.)

$2+4+4+2+3=15\div5=3$ threads for the average.

$3\times15=45$ threads per inch.

It frequently happens that the average number of threads includes an inconvenient fraction; to avoid one calculation with this fraction, multiply the sum of the contents of the dents, by the dents per inch, and then divide by the dents per set.

* NOTE.—The shrinkage of the goods must always be borne in mind, and included in estimates. Allowances for "take-up" of yarn in weaving, waste, etc., must be taken into account. Arbitrary rules in relation to these allowances are of little use; there is much variation in different mills and under different circumstances. The convenience of minute records on such subjects is apparent.

EXAMPLE.—What are the threads per inch when the warp is reeded as follows in a No. 15 Reed:

3, 4, 4, 3, 3, per dent, (making 5 dents per set.)

$3+4+4+3+3=17 \times 15=255 \div 5=51$ threads per inch.

To Estimate the number of Heddles required upon each Harness.—Multiply the number of threads on each harness per pattern by the number of patterns in the entire warp. Example—Warp, 4,800 threads. Drawing in draft reads as follows:

1	2	3	4	—	—	7	8	—	—	—	—
—	—	—	—	5	—	—	—	9	10	—	—
—	—	3	4	—	—	—	—	—	—	11	12
1	2	—	—	—	6	—	—	9	10	—	—
1	2	3	4	5	6	7	8	9	10	11	12

No. of Harness.	Th'ds per Patterns.		Patterns per Warp.		
1	3	x	160	=	480
2	3	x	160	=	480
3	3	x	160	=	480
4	3	x	160	=	480
5	2	x	160	=	320
6	2	x	160	=	320
7	2	x	160	=	320
8	2	x	160	=	320
9	3	x	160	=	480
10	3	x	160	=	480
11	2	x	160	=	320
12	2	x	160	=	320
Total Threads	30				4800

When the drawing-in draft is very irregular this method is convenient because so easily proved.

S.

SAMPLES.—It is highly important that every factory preserve samples of all the kinds and variations of goods made, also samples of the stock, yarn or colors which cause the variations, with lucid records. If it is important for the factories, it is doubly so for managers, designers and overseers. Sample books are perhaps not to be depended upon as evidence of much knowledge, however well filled; but they may show an extensive experience, and their condition will indicate many habits of the compiler.

Sample Yarns.—Ashton recommends that a collection of samples, accurately numbered, be used for comparison until great familiarity with yarns makes them unnecessary; he advises washed yarns only. The better way is to take a liberal portion of the samples of each size, wash it thoroughly, when dry (let the skein hang loose while drying) label it with the numbers, showing the then actual weight and size, by all the most common systems of numbering; to the clean skein tie the remainder of the skein of raw yarn, similarly labeled. If then the raw yarn is numbered by the spinner, and the washed yarn is renumbered after shrinkage, the comparative shrinkage of different sizes will also be exhibited by the difference in marks upon the labels, clean and raw. Other comparative memorandums may be attached, all of which is little trouble. The benefit in return is inestimable.

Sanders or Saunders.—This is the wood of a tree grown in the East Indies. Is harder and more resinous than Barwood or Camwood, but considered by many as a species of Barwood. Astringents such as sumach, galls, etc., help to extract the coloring matter. Alcohol will extract it entirely. This wood requires more boiling than any other dyewood to extract the color.

Satin.—Real satin is a silk fabric in which the warp is allowed to float over the filling in a manner covering it entirely and presenting a smooth, lustrous face.

Satinets.—Are part woolen fabrics, in which the face shows only the woolen filling, the cotton warp being less prominent or out of sight. A good satinet is a very serviceable piece of goods, and many a workman would be content with a satinet suit if well made; but few satinets can now be produced without the introduction of an excessive amount of short staple, the ruling market prices being so low.

Satinettes.—A cheap imitation satin.

Scouring.—Scouring implies a more severe treatment than washing. Scouring wool and woolen goods is an exceedingly important branch of woolen manufactures; besides requiring, on the part of those in charge, a thorough knowledge of chemistry, as far as applicable, it also demands a wide experience. The water should be analyzed, the nature of the chemicals used and their action upon the material and impurities thoroughly understood.

Selisia.—A cotton fabric quite firm, with a gloss finish upon the face side, used for lining.

SELVAGES.—The selvage is a narrow band woven on the edges or sides of goods, and, in some way, made to ornament rather than detract from the general appearance of the piece when right and as they ought to be. To neglect this is quite common among operatives; for this there is the excuse of ignorance of the importance of selvages, but there is no excuse for those who have had better advantages to observe the benefit of handsome effects. Handsome because clean, clear, perfect and in proper contrast of colors or fabric or both. The selvages must endure more chafing from the shuttle and reed than the body yarn, consequently, they should always be made of yarn a little stronger than that used in the main fabric, unless there is special and good reason for the contrary. Selvages are made long and short, etc., for the same reason as the edges (which see), but all troubles of this kind are usually worse in selvage than further in. There is another cause for long and short selvages, which is independent of the body goods, and that is the difference of texture between selvage and cloth adjoining, which will occasionally make the warp and selvage yarn take up differently. It is sometimes necessary to weave two or more widths in one loom, in which case it will be necessary to bind the outside selvage threads where two selvages adjoin, or the selvage will ravel out easily. This is done by means of a pair of lace heddles for each inside selvage. Selvages should be neat and show good taste. Ugly selvages on a good piece of cloth may be compared to an old hat and boots on a person otherwise well dressed.

SETS.—Certain complements of machinery or parts thereof, threads, patterns, etc., etc. The "set" of cards includes all the cards through which the same stock must pass to complete the process. For woolen carding three cards, differing only in the manner of entering and delivering, size of wire and speed of certain parts, complete the most common set. In worsted cards or scribblers the several cylinders are usually all combined by one frame, thus making one machine of what at one time were separate parts of a set. The number of cards in a cotton set vary very much. (See Sett.)

SETT.—A term used in England "to indicate the pitch or the fineness, or the distance apart of the warp threads as they are separated or distributed over the fabric by the reed. By the Lockport system the sett is indicated by the number of reeds or splits per inch; and the number of ends through each split is understood to be two, unless when otherwise expressed; consequently what

would be termed a thirty sett would represent 60 ends per inch. The great variety of setts used in England is well set forth in the following quotation from Thomas R. Ashenhurst:

"If we leave Stockport and take what is known as the Manchester and Bolton system we have something totally different. By this system what is termed the sett is the number of Beers of 40 ends each in $24\frac{1}{4}$ inches. If we leave Lancashire and enter Yorkshire we find different systems again in use. At Huddersfield the old sett system was based upon the number of Beers of 38 ends each in 30 inches, but I understand many of the firms have abandoned this and adopted the reeds per inch as their sett. If we go from Huddersfield to Holmfirth, a distance of some six or seven miles, we find their system is based upon 10 ends per foot, so that if there are twenty times ten ends, or assuming two ends in each split, twenty times five reeds in one foot, it would be termed a twenty sett, or if reduced to the same system as the others it would be the number of Beers of 40 ends each in 48 inches. If we take other woolen districts we shall find the calculation based upon the number of Portits, Porties, or Porters, as they are variously known, in a given number of inches (the Portit and the Beer are the same thing known by the different names in different districts.) The Portits, as well as Beers, are variable quantities according to the custom of the district, and the number of inches which is taken as the basis is different also in each district. If we leave the woolen district and come into the Bradford worsted district, we find the sett system based upon the number of beers of 40 ends each in 36 inches. In Scotland the sett is reckoned by the number of reeds in 37 inches, thus if there are 1200 reeds in 37 inches it would be called a twelve hundred reed, and there are always two ends through each split unless otherwise expressed, consequently a twelve hundred set means 2400 ends in 37 inches. In some of the silk manufacturing districts the sett is indicated by the number of reeds in the width of the piece, and the ends through each split stated at the same time; thus there may be 1200 reeds in 18 inches, and eight threads in each split. It would then be called twelve hundred eight thread, eighteen inches; or if the piece was 24 inches wide it might still be a twelve hundred eight thread. But in the one case there would be $66\frac{2}{3}$ splits per inch or $533\frac{1}{3}$ ends per inch, and in the other case there would be 50 splits or 400 ends per inch. I have enumerated only a few of the systems in use; it would not be very difficult to increase the list considerably, but those I have named will be sufficiently representative for our purpose. To convey a little more

clearly to your minds what these different systems represent I will make a few comparisons. Most people engaged in the Bradford manufacturing trade are familiar with the term 60 sett.

By Bradford	system	60	sett	represents	$66\frac{2}{3}$	ends per inch.
" Stockport	"	60	"	"	120	" "
" Huddersfield	"	60	"	"	76	" "
" Holmfirth	"	60	"	"	50	" "
" Bolton	"	60	"	"	$98\frac{24}{97}$	" "

Or to enable me to include the Scotch and silk trades in the comparison, I will take a Bradford 60 sett and I find it will be equal to Bolton $40\frac{5}{12}$

Stockport	$33\frac{1}{3}$	
Huddersfield	52	on the old system.
Huddersfield	$33\frac{1}{3}$	on the new system.
Holmfirth	80	
Scotch	$1233\frac{1}{3}$	
Silk	800	two thread 24 inches."

SHED.—The separation or opening in the warp threads on the loom, made by means of the harnesses or the jacquard machine for the shuttle to pass through, at the same time leaving a thread in the shed which is beaten up to the cloth by the lathe. The shed is then changed for the next passage of the shuttle; each such passage is called a pick. Upon the correct timing of the opening and closing of the shed, upon a perfect, clear, neither too high or too low, too tight or too loose a shed much depends. Open the shed too late or close it too early the shuttle is more or less obstructed in its passage. The evil may be so bad as to throw the shuttle out, or only to make the warp go bad at the sides, but to whatever degree this evil exists, rough and imperfect edges in the goods is a sure consequence. Too high or too low a shed is often the result of heedlessness in starting a warp, sometimes the loom fixer tinkers with the shed motion to make the shuttle behave, when the trouble is in the picking or box motion, which must be timed correctly as well as the harness mechanism. Tight or loose sheds are not altogether produced by the take-up and let-off motions. If the whip roll and breast-beam are both too high, the lower shed will be tight, the upper one loose, the contrary position of these two pieces or parts will reverse the effect on the shed. When only one of them is out of line the evil is not so perceptible in the shed unless there are many harnesses, in which case the harnesses near or far away from

the part in wrong position will be differently affected, which will cause an uneven shed. These are points which prove seriously troublesome in some goods, while in others they must be made use of to produce the right effect or to humor a warp.

Shoddy.—Stock which has been recovered from yarn or cloth by conversion into staple sufficiently good to spin again. There is a great difference in the success of different operators with the same stock and machinery. Shoddy is very useful, almost indispensable in some kinds of goods; it will yield a better nap than longer stock. Shoddy made of old rags is not good, being lifeless, lustreless and cannot give goods the proper character or strength; it is from excessive and fraudulent use of this class of stock that the prejudice against shoddy has arisen. Good shoddies may also be used to excess, and the goods weakened thereby, but the expert manufacturer discovers the difficulty before the goods are made by the reduction of product—a serious matter in American manufacturing. Flocks are not shoddy, in the present use of the word.

Shoddy Pickers.—These are only a variation of the waste pickers to adapt them to the more difficult work of unraveling cloth instead of yarn.

Shellac.—"Shellac or lac is a resinous substance which, in India, flows from certain trees in the form of lucid tears, in consequence of punctures made upon their branches by a small insect. Shellac is very apt to be adulterated with common resin, and hence, unless when a pale lacquer is required, most artisans prefer seed lac. When lac is mixed with a little resin and colored with vermillion or ivory black it forms sealing wax. Shellac is soluble in alcohol but not in turpentine. It is also soluble in alkaline solutions, including ammonia. A solution of borax in water dissolves it readily, and the resulting solution has been used as a cement, as a varnish, and as a basis for indelible ink. It is much used by hatters as an insoluble cement."—*Workshop Companion.*

Shuttles.—Shuttles are the vehicles for carrying the filling into and through the warp shed. Upon the employment of the proper shape and weight in shuttles much depends in the running of looms. In the particular of quality and kind of wood used in shuttles Europe is far in advance of this country, and American manufacturers suffer not a little, from the false economy exhibited in the purchase of cheap shuttles.

Silk Mixtures.—Any fabric in part made of silk may properly

be called a silk mixture; but the goods known by this trade name are cassimeres wherein fine lines or dots are produced by the introduction of a small percentage of silk threads, with or without twisting the silk with a woolen thread. Silk mixtures cannot be fulled so much as some other goods, and should be cautiously cleared on the gigg, not depending upon the shear for anything but to shorten or cut off the nap.

SIZING.—Sizing upon goods and yarn are applied for various purposes. In goods to give weight, to afford a proper base for printing, on some worsted fabrics, for a preparation to subsequent cleansing, etc. On yarn to weight it, to fit it for the wear and tear it must be subjected to in weaving, etc. Many recipes for sizing may be found in works on Warping in the "Queries and Replies," Webb's "Warp Sizing," Dick's "Encyclopedia of Practical Recipes," &c.

SOAP.—The manufacture of soap for use in factories is a branch of no little moment; the opportunities to deceive are so great that the most unscrupulous practices are common, so much so that it behooves manufacturers to trust to no recommendation except extensive tests and trials under the most careful supervision in their own works. We give a common formula for a cheap oil soap that may be varied to suit many kinds of work. This in particular, because it is a soap that may be made and used in many factories:

For 6 barrels of red oil fulling soap, 50 pounds of soda ash, 6 pounds of rosin, 36 pounds of saponified red oil; water to boil before putting in soda ash, then rosin, then oil. Boil four hours. For scouring soap same as above, except 60 pounds of soda ash, 6 pounds of rosin, 14 pounds of saponified red oil. The more oil the heavier body of soap. Some boil in one-third of the water, and add balance when nearly done.

SPINNING.—Of spinning little more can be said than of carding. The subject is at this time being very extensively discussed in journals devoted to manufacturing interests. The consideration thereof is therefore deferred for the time when a revised and enlarged edition of this work will permit a thorough and exhaustive treatise.

SPLITS.—The dents in a reed are called splits quite as often and commonly as dents.

SPONTANEOUS COMBUSTION.—The frequent recurrence of fires from this cause has led to many theories and some scientific investigations of the subject. Clean, dry stock of any kind seldom

ignites; but, as the use of oils and dyes are indispensable about a factory, the greatest caution is not always sufficient to avoid this danger.

Spooling.—Spooling yarn implies that the yarn or stock is being put upon spools. In the carding room the sliver is sometimes taken from one card in coils, a number of which are put upon a large spool, from which the stock passes into the next card; this or any other process of spooling sliver or drawings in carding and spinning is being rapidly superseded by more convenient methods of transferring the stock. Yarn is spooled in many different ways according to the purpose for which it is done. There is spooling from the skein, from bobbins, or from spools. There are machines for putting one thread upon each spool, yet others for 20 to 120. On machines of this latter kind there is usually a measuring device that the exact quantity upon the spool may be known or regulated. Upon even and careful spooling the subsequent process of warping is very dependent for good results. The process seems simple, but it is so important that the common practice of placing it in charge of ordinary ability causes a greater loss in waste than is gained in wages.

Spools.—This term now implies a barrel and two heads; the variety of spools is legion, and for each kind there are many ways of making and fastening the heads. The most durable are the best, provided the wood is such as to wear smooth. Too much economy in bobbins and spools costs many mills more than the price of a full set every year. The principle that by keeping the factory in want of bobbins is the best method to keep down the surplus stock, may deceive some, but they had better apply more beneficial methods, and produce the result in a less costly manner, if it must be done, which is altogether a question relative to the character of the surplus.

Stop Motions for Looms.—These are devices for stopping the loom when a shuttle fails to reach its box; others when the filling breaks or runs out, and yet others when a warp thread breaks. The first are now on all power looms in some form. The second are quite common for plain looms, and being introduced for fancy looms. These stop motions are both expensive and not always a saving, since they have been known to do much damage by marking the goods; this is, however, owing to a failing in adjustment of the feelers, or the peculiar kind of goods woven. They must be well understood to prove satisfactory. The warp stop motions are not

yet adopted in general use, the mechanism required being so delicate and complicated that the device will serve better as a curiosity than anything else. Notwithstanding this fact, however, the inventors have displayed an unusual amount of perseverance and ingenuity.

STRIPPERS.—The small cylinders upon the carding machines which strip the stock from the workers. This name is also applied to other devices for the same work, to the persons who clean cards, to the hand cards used in cleaning, etc., etc. The last-mentioned are made in many ways; what is called the English pitch is much preferred by most carders now, but some have become prejudiced against the English pitch on account of failures in American imitations, the leather used being poor or the bend in the wire being incorrect.

STRIPPING CARDS.—To unclog the teeth it is not enough to rub the hand card over the roller, for evidently we should only injure the teeth without reaching all the wool kept in the card clothing. The hand card is taken in the hand, the teeth nearest the handle placed upon the teeth of the roller, and the wool pricked by raising the head of the card; a slight motion is then given it, which draws out the wool. After having stripped all the cylinders of the breaker, they are treated with emery and finishing cloths. For stripping the teeth of a fancy, a comb with steel needles has been successfully used.

SUMACH.—A native plant of Syria, now cultivated in many other parts, notably in Spain, Italy, Portugal and Sicily. It is brought to market in a powdered state. The odor, when a decoction of it is boiling, is not unlike that of good tea; the color, fawn drab; acids make it more yellow, and the alkalies more brown, or toward orange. Ground Sumach contains about one-sixth of its own weight of tannin.

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TABLES.—The use of tables is to save time and labor; there are unlimited opportunities of increasing their number and the usefulness of many extant. Several pages of this work are devoted to tables in daily need by many. They are not so elaborate as some, but on the other hand they are simple, convenient, accurate and large enough for many purposes. Lawson's reed table is more complete in detail than those herein contained, and is in the form

of a sheet which may be framed or mounted, a feature desirable in some instances; indeed, some prefer this form to those found in books because the entire table is in full view; on the other hand, it cannot be used so conveniently in combination with other tables or stored away as a book may be. Some of the tables are also to be found in other forms elsewhere, but the table of the capacity of looms is new, and when well understood will be in constant use.

Tapestry.—Tapestry is an ornamental figured textile fabric of worsted or silk for lining the walls of apartments; the term also includes carpets and other fabrics, for household decorations. The manufacture of tapestry, such as carpets, oil-cloths and lace, is localized in peculiar districts in a remarkable manner. Kidderminster, Wilton, Glasgow and Halifax contain extensive factories solely engaged in the production of the various descriptions of carpets in ordinary domestic use. The application of the power loom to the carpet manufacture is recent, and its use is extending. There are a great variety of combinations of materials, many of which indicate a remarkable departure from the ordinary method of manufacturing carpets and similar objects. One of these is a species of mosaic tapestry, where the cut wool is fixed to a ground or foundation of caoutchouc.

Tappets.—Changeable cams used on looms for various purposes, the tappets for the box and harness motions being the most common. When the cams are fixed so that no others can be conveniently put in their place the looms are commonly called cam looms. When the cams are changeable they are called tappets, and consequently the loom a tappet loom.

Teasing, Teaseling, Teaselling or Teasel.—The Scotch and English use this word for the operation here called gigging. This accounts for the name of teasels.

Teasels.—"[A-S., tœsel, tæsel, the fuller's herb; O. H. Ger., zeilala, id.] [Written also tassel, tazel, teasle and teazle.]

1. (Bot.) A plant of the genus depsacus, of which one species (D. fullonum) bears a large burr or flower head covered with stiff, prickly-hooked awns or bracts, which, when dried, is used for raising a nap on woolen cloth.

2. The burr of the plant.

3. Any contrivance intended as a substitute for teasels in dressing cloth."—*Webster's Dictionary*.

For further particulars of using and setting, see gigging.

TEASERS.—English and Scotch for giggs, for the people who operate them, and in some sections for wool pickers also.

TEMPLES.—If a weaver understands setting them up, and attends to it faithfully, the old-fashioned bar temples will do most excellent work. But weavers are not disposed to be bothered with temples if any automatic contrivance will do the work. The rapidity of power looms makes it difficult for a weaver to see imperfections on the small space of goods between the bar temples and the shed. There can be no worse temple for any kind of goods than a pair of dilapidated hooks connected by a miserable strap, 40 or 50 pounds of old castings, said strap running down over the end of the breast-beam with nothing better to keep it in its place than the groove it has worn. To have 4 or 6 hooks in the end of a strap, 2 to 3 inches wide next to the cloth, about three-eighths of an inch wide, from within 4 inches of the cloth to the weights, running over a pulley as near the lathe as possible, and at least two feet from the cloth; weights which will answer to draw the cloth to its proper width, but occupying little space as possible, and treadles to lift and let them down gradually when setting, may all help to make this class of temples answer, but at best they are not perfection. An automatic temple is wanted, which will do all kinds of work, require little repair and be easily adjusted. The nearest approach to a perfect temple that has come to our notice is an English invention; if we should speak of it here as we think, our remarks would read very much like an advertisement. There is this about it, however, it is somewhat complicated and troubles many weavers at first. A little perseverance is needed.

TEMPLE MARKS.—When strap or bar temples are not regularly and frequently set, hold the goods too wide or not wide enough, draw too much in the direction toward the cloth beam, chafe or tear the goods; or if the goods are slazy, temple marks are pretty certain to occur. They show much more on some goods than on others, but ought not to exist. After picking out, a weaver sets up temples to take up the slack at the sides. A temple mark is an almost sure consequence. Automatic temples will mark the goods principally by chafing and slipping. The temple needs much attention, but when once right it is easily kept there if closely watched.

TENTER BARS.—Notwithstanding all the many ingenious inventions on the drying machines in use, there are some points in which all are yet inferior to the tenter bar, when gotten up and fitted out

with the best and latest improvements. The stretching is on no machine under such accurate control. Since the introduction of Lacy's tenter clothing the edges cannot come from any machine in better shape and condition than the bars having this almost indestructible clothing, instead of the old-fashioned tenter hooks. The slow process of drying on bars may not be the cheapest as regards the cost of labor, but the effect on some goods is worth many times the cost of the extra labor.

TEXTURE.—Texture is a term used to designate the binding or interlacing of threads necessary to produce a fabric. Texture does not, therefore, mean the fabric, nor yet the yarns whereof it is made, but the construction whereby it is made with the yarn. The simplest texture requires four threads, two each way, one pair being at right angles to the other. By constructing a few of the simplest textures with pieces of tape, any one who must learn the nature of textures from the very foundation will be much benefited. Proceed as follows: Take 4 pieces of tape, each 1 inch long, lay two parallel (side by side) upon the table; call these the warp threads; the ends toward you we will suppose to be pointing toward the cloth beam; these should be pasted to a pieces of paper. The other ends toward the warp beam; these are better to be left loose. The left hand one, mark No. 1, the other No. 2. You are now ready to put in the first pick, which is easily done by slipping one of the remaining pieces of tape over the end of warp tape No. 1, and under No. 2, next to the paper. The second pick put in at the other end, but contrary to the manner of the first; that is, under No. 1 and over No. 2. The result is a fabric of the simplest texture possible. But this is not only the simpelst texture, the fabric is about as limited in size as in texture. A fabric may contain more threads each way, in which case they must, of course, be longer. The increased number of threads are bound into a larger fabric, but the texture remains the same, being simply repeated. Let the student prove this and learn several points by the operation. Cut 12 pieces of tape, each 3 inches long, paste the ends of 6 upon a strip of paper 2 inches long by $\frac{1}{2}$ inch wide, so that the 6 pieces of $\frac{1}{4}$ inch tape (side by side) will have equal spaces between them. Upon two other papers paste the other 6 pieces, 3 on each, leaving about $\frac{5}{16}$ inch space between the pieces of tape; place the paper with 6 pieces next to yourself, the free ends pointing away from you, this will again represent the warp. At the right hand lay 3 of the filling threads, at the left the other 3. Number

the warp threads, from the left, 1, 2, 3, 4, 5, 6; the filling threads number alternately, the nearest left hand No. 1, the nearest right hand one No. 2, the next left hand one No. 3, and so on. Now enter No. 1 filling thread, over No. 1 warp thread, under 2, over 3, under 4, over 5, under 6, next to the paper. From the other side enter filling thread No. 2, next to No. 1, over warp thread No. 6, under 5, over 4, under 3, over 2, under 1. Filling thread No. 3 enter like the first next to No. 2, No. 4 like No. 2, No. 5 like No. 1 again, No. 6 like No. 2. This constitutes a fabric with three repetitions of the texture each way, technically speaking three "repeats" each way; and it has been constructed just as the loom must do it in principle. The loom is more practical with its contrivances, having mechanism for lifting all thread simultaneously, another for passing a shuttle through the opening between the raised threads and those left down, said shuttle carrying with it a coil, or bobbin of filling in such a way as to leave a thread behind it, in the said opening, properly called shed. To represent the shuttle coming from each side, alternately, the tapes have been entered from both sides, to keep the tapes in their proper order it has been necessary to fasten the ends; in the loom this is done by the heddles and reed. The heddles lift and lower the warp threads, and the reed beside keeping the yarn evenly spread next to the cloth, is brought up against the cloth after each pick has been entered, which forces the filling threads together. The construction of the simplest texture being understood, the application of the principle to produce large fabrics by many repetitions of the pattern or single textures being comprehended, the student is prepared to proceed to other textures. The same tapes will answer for many; longer ones, and more of them may be prepared in a similar manner, or the frames made for the purpose purchased with instructions or made from the following description: A frame something like the frame of a slate in appearance has tapes stretched one way, as close together as convenient, in number according to the size of frame—12 inches will admit about 40. The filling tapes are fastened by one end at the sides. These frames are very convenient, and can be made or purchased without much trouble. The next step is to represent textures on paper; this is quite simple after a little practice with the tape. Take quadrilled design paper; the rows of squares up and down, as the paper lays before the student, represent warp threads. The lines of squares, horizontally, represent filling threads. Since fabrics are made up of repetitions of the texture, and the loom duplicates the application of it to the threads, it is necessary to rep-

resent a texture only once on the paper, such representation forms the part of a complete design designated by the term chain draft, because by it, the pattern chain is built, whether the chain be of paper, wood or iron. In writing a draft, its beginning and ending must be the same as if another repetition of the draft were to be placed on either side of it. This is necessary because such is really the case in the goods, when the directions of a perfect draft are carried out by the loom. Below are representations of some of the elementary textures; any one of them is a complete chain draft:

No. 1.

```
2*□
1□*
 12
```

No. 2.

```
4*□
3*□
2□*
1□*
 12
```

No. 3.

```
10*□
 9*□
 8*□
 7*□
 6*□
 5□*
 4□*
 3□*
 2□*
 1□*
  12
```

No. 4.

```
3*□□
2□*□
1□□*
 123
```

No. 5.

```
3□**
2*□*
1**□
 123
```

No. 6.

```
6*□□
5□*□
4□□*
3*□□
2□□*
1□*□
 123
```

No. 7.

```
6□**
5*□*
4**□
5□**
2**□
1*□*
 123
```

No. 8.

```
6*□□
5□**
4**□
3□□*
2**□
1□□*
 123
```

No. 9.

```
6 **□
5 □□*
4 **□
3 □**
2 *□□
1 □**
  123
```

No. 10.

```
4*□□□
3□*□□
2□□*□
1□□□*
 1234
```

No. 11.

```
4□***
3*□**
2**□*
1***□
 1234
```

No. 12.

```
4***□
3□***
2**□*
1*□**
 1234
```

No. 13.

```
4**□□
3**□□
2□□**
1□□**
 1234
```

No. 14.

```
4**□□
3□**□
2□□**
1*□□*
 1234
```

No. 15.

```
4*□*□
3**□□
2□*□*
1□□**
 1234
```

No. 16.

```
**□□
□**□
*□□*
□□**
1234
```

No. 17.

```
5*□□□□
4□*□□□
3□□*□□
2□□□*□
1□□□□*
 12345
```

No. 18.

```
5□****
4*□***
3**□**
2***□*
1****□
 12345
```

No. 19.

```
5**□□□
4□**□□
3□□**□
2□□□**
1*□□□*
 12345
```

No. 20.

```
5□□***
4*□□□*
3**□□*
2***□□
1□***□
 12345
```

No. 21.

```
5****□
4**□**
3□****
2***□*
1*□***
 12345
```

No. 22.

```
6*□*□*□
5*□*□*□
4*□*□*□
3□*□*□*
2□*□*□*
1□*□*□*
 123456
```

No. 23.

```
6***□□□
5***□□□
4***□□□
3□□□***
2□□□***
1□□□***
 123456
```

No. 24.

```
6**□*□□
5***□□□
4□**□□*
3□□*□**
2□□□***
1*□□**□
 123456
```

No. 25.

```
6*□□□**
5**□□□*
4***□□□
3□***□□
2□□***□
1□□□***
 123456
```

No. 26.

```
6*□□**□
5**□*□□
4***□□□
3***□□□
2□**□□*
1□□*□**
 123456
```

No. 1 represents the plain texture first illustrated by the experiments with tape. This texture is called "cotton weave," "sheet weaving," "plain cloth" and by many other appellations, the derivation of which is almost self-evident. From this base one may branch out into many variations. No. 2, for instance, is like No. 1, but two lines being alike, the respective picks in weaving will have the same shed opened for them, consequently the filling threads will be doubled in each shed. This is called weaving with 2 picks in a shed. It is done for various effects and purposes. No. 3 is an extension of the same idea to 5 picks in a shed, such a chain with the proper yarn would produce a fabric called "repp," or "cross cord." No. 4 is already an enlargement of the first texture represented and cannot be made to look entirely plain because the change from thread to thread, of the one harness up, causes a diagonal effect. While such effects are small but distinct, they are termed twills. No. 4 is then a 3-harness twill. The filling shows much more than the warp on the face. Therefore, this is a filling-face twill. No. 5 is the same, but because two-thirds of the warp yarn passes over the filling it is called a warp-face 3-harness or 3-leaf twill. No. 6 is like No. 4 for 3 picks, the other 3 picks being really the same texture, but applied in a different order. This is a variation of the No. 4 texture which, with some yarns, makes a face that appears to be almost plain, therefore, it is sometimes called "plain 3-leaf cloth." The same difference is exhibited between No. 6 and No. 7 as between No. 4 and No. 5. One being a filling-face the other a warp-face. Already the student will have noted that to be a filling-face texture the warp threads must go down in the larger proportion and *vice versa*. Such observations give the cue to quick comprehension of special characteristics in more elaborate texture, and particularly in combinations of textures. No. 8 and No. 9 are the first steps at combination. These chain drafts combine the texture of No. 1 and No. 4 in No. 8; of No. 1 and No. 5 in No. 9. The student should now examine the texture of the individual warp threads or harnesses, also the filling threads or picks, and study out the combination principle without aid. No. 10 is similar to No. 4, but with one more harness and pick per pattern. Were the fifth harness in No. 17 like the first it would be the same 4-harness twill as is represented in No. 10, with one thread too many. This thread might be the one of another repetition of the texture, in which case it would be wrong to have it appear on the draft; but it might for certain effects be desirable to have 5 threads in the pattern—the first and last to work alike when it

would be proper to leave it on the draft, but not really necessary, because there is another way of producing the same result, namely: to have only 4 harnesses, when the fifth thread is reached in drawing the threads into the heddles, draw it into a heddle on the first harness, then the first one of the next pattern would have to be drawn on the first harness also, the second on the second, and so on until the fifth is reached again, which is to be placed on the first every time, as before. This slight digression will admit a little light on the cross draw principle, which is duly considered elsewhere. No. 11 and No. 12 are the same texture, but the order of the threads is changed. No. 13 is the same as No. 1, but doubled every way. No. 23 is the same, but has 3 threads working alike each way. This variety of textures are called "basket weaves," probably because the several threads working alike lay side by side and give the appearance of narrow strips that have been plaited. No. 14 is another 4-harness twill. It is a very common texture, often named from the class of goods made with it—"Kersey twill," "cassimere weave," "double treadle twill," etc. Nos. 15 and 16 are the same as No. 14, but the twill is broken by a different order of the threads working the same. Broken twills are much used for mottled effects. Nos. 24 and 26 are of this order. No. 21 is also sometimes called a broken twill, but in reality it is a double twill. It is commonly called the doeskin weave. It is needless to encumber space here with further illustrations; most complete collections of textures are procurable. Besides studying such collections, the student should give much time and attention to work out the principles here illustrated in larger effects, with more harnesses, without aid, and when such a task is completed compare notes with some one or with the same thing as given in some of the collections referred to. So far the textures considered have all been single. Combinations may be called compound fabrics, if a name must be produced. Double fabrics are such as have two textures, one above the other. Triple fabrics are the same, with three textures. In this class the textures may be separate, here and there tacked together, or so incorporated in each as to be one solid mass or interchangeable in their appearance in either by parts. In taking up double textures only the simplest kinds are illustrated here, elaborate designs of this kind must not be attempted until the principles and elements underlying them are fully comprehended. When this point is reached a large collection is of more use than a few examples, and more could not be given here. We begin again with texture No. 1 by doubling it. No. 27 represents this texture

separate; that is: if this chain were used, the loom would simply make two pieces of cloth, one above the other. No. 28 shows one way of tacking the two together, this is done by raising the back warp (harness No. 2 and harness No. 4) for the face filling shed. The addition to the draft to produce this result is in a different character from the others (⊕) not because it must be different or of particular shape or kind, but because it is very convenient always to mark this place usually called the "binder" and the threads so used to bind fabrics and textures together, called binding threads. In No. 29 the two textures are the same, but bound together differently. In No. 28 the back warp threads were raised to let a face filling thread go under them; in No. 29 the face warp threads are lowered when a back filling thread is going through; thus it is incorporated into the back fabric, besides doing regular service on the face fabric, consequently binding the two together. To be systematic some designers never call a face thread the binder, always the backing thread which helps to make the union. According to this in No. 28 the back warp threads would also be binding threads; in No. 29 the back filling threads. The difference between No. 27 and No. 29 is designated by a cipher (○) in the space which should otherwise be a blank square, (□) and must be considered a "sinker." It is very common not to bind textures together so frequently, as will be seen further on. The principal feature of a double cloth draft is, that for the face pick only those harnesses are raised which represent threads that must pass over face filling. All the others must be let down. This lets down *all* of the back warp and a part of the face warp. When the back pick is to go through all of the face warp and some of the back warp must be raised, leaving only such threads down as must pass under the respective back pick. Backing is sometimes attached not as a separate fabric, but as backing only, (for instructions see BACKING.) No. 30 is a double cloth with the same twill on back and face as texture No. 14. No. 31 is the same as No. 30, but shows one of the many ways of attaching the two fabrics to each other. No. 32 is the same as No. 27, but by a different arrangement the binding is regular and one which is usually very safe because not so close as Nos. 28 or 29, and not showing through so badly. It also does away with the little dimple other bindings make in some fabrics. The back and face texture are not always alike, neither is the yarn always the same. No. 33 illustrates a double texture of this kind, the face being like texture No. 25, a plain 6-harness twill, the back like No. 5, a plain 3-harness twill filling back. The warp face of the back fabric being under

the face fabric. The density of the threads also differs in this, there being two face threads to each back thread. In such fabrics it is customary to use fine yarns in the face fabric, coarser in the back fabric. No. 34 illustrates that the double cloth texture need not be confined to twills but can be applied to any texture. The fact that more harnesses being required for double than for single textures must be borne in mind. No. 34 is a basket face and a broken twill back. Note that the binding is done in both ways in this draft:

No. 27.

```
4***□
3□□●□
2*□**
1●□□□
 1234
```

No. 30.

```
8*□□□□□*□
7*□*●*●*□
6*□*□□□□□
5*□*□*●*●
4□□*□*□□□
3*●*□*□*●
2□□□□*□*□
1*●*●*□*□
 12345678
```

No. 33.

```
9●*●●○□□□□
8□□●●*●□○□
7*******□*
6□□□●*●●○□
5□○□□□●●*●
4*□*******
3●○□□□□●*●
2●*●□○□□□●
1****□****
 123456789
```

No. 28.

```
4***□
3□□●⊕
2*□**
1●⊕□□
 1234
```

No. 31.

```
8*□□□□□*□
7*□*●○●*□
6*□*□□□□□
5*□*□*●○●
4□□*□*□□□
3○□*□*□*●
2□●□□*□*□
1*●○●*□*□
 12345678
```

No. 34.

```
12●□●□●□□□□□□□
11*□*****□○□**
10●□●□●⊕□□□□□□
 9***□***□***□
 8●⊕●□●□□□□□□□
 7*****□***□○□
 6□□□□□□●□●□●□
 5*□○□***□****
 4□□□□□□●□●□●⊕
 3*□***□***□**
 2□□□□□□●⊕●□●□
 1***□○□*****□
   1 2 3 4 5 6 7 8 9 10 11 12
```

No. 29.

```
4**○□
3□□●□
2○□**
1●□□□
 1234
```

No. 32.

```
12□***□***
11□*□□□*□□
10*□□*□□□*
 9**□***□*
 8□*□□□*□□
 7□□□*□□**
 6□***□***
 5□*□□□*□□
 4□□□**□□*
 3**□***□*
 2□*□□□*□□
 1□□**□□□*
  12345678
```

```
8*□*□****
7□□□□***□
6*□*****□
5□□***□□□
4*****□*□
3***□□□□□
2***□*□**
1*□□□□□**
 12345678
```

Many of the more elaborate designs can be produced by a combination of several textures. Notably ingrain carpet, two-ply and three-ply. In such goods the yarn, when not required in the face fabric, is bound into a texture on the back which at once adds firmness, warmth and durability. Other goods are made with a face and a back fabric, and any yarn or threads not needed in the face or back allowed to float between the two; they are there out of sight and the danger of being drawn or pulled in finishing or weaving. In woolen goods that must be fulled, it will not do to allow these floats to be too long or many, as they roll together and make uneven thickness in shrinking.

The characters used in the foregoing drafts are :

∗ and ⊕ for raisers, □ and ● for sinkers.

TICKINGS.—A heavy cotton fabric, most commonly blue and white checks or stripes, and a warp twill texture.

TIES.—This word has many erroneous applications. It is used by some in place of fabrics, the arrangement of harnesses, compound fabrics, etc. The proper use for the word is now generally acknowledged to be limited to the manner or peculiar ways of fastening several fabrics together into one, when this is done with a special arrangement of the threads for the purpose. The manner of tying the back and face together is illustrated by Texture Drafts Nos. 23 to 35. The manner of making double and triple cloth, and having the yarn interchange in the several fabrics, is also exemplified.

THREAD-BARE.—A name for the finish on goods which leaves no nap.

THROSTLE FRAME.—For cotton the frame in its transverse section is similar to the throstle frame used for combed wools. A cylinder, bearing the roving, is at the summit of the frame. The roving in its descent becomes engaged between two drawing rollers at a proper distance apart, and surmounted with top rollers. The drawn out roving passes through a fly terminated by a tube, and is wound off and twisted by the rotation of a spindle. Each spindle receives its motion from a drum placed underneath the frame.

TOOLS.—Tools are a great necessity of the present day. Manufacturers are sometimes compelled to be stingy in supplying them, because the workmen they employ are either dishonest, careless or incapable. It would seem that this would be a good criterion by which to judge employees, and we contend that it is; that the best and cheapest workmen are those who can be entrusted with good tools. But workmen must become accustomed to tools to make the best use of them; if, then, they were to find tools different whenever they changed places their beginning would not be so satisfactory. Some tools they should own and take with them, and manufacturers should encourage it by replacing tools lost or damaged in their service, without a fault on the part of the owner. From the designer down to the most common laborer, the best results are attained at the least cost of material, time and exertion only when the best attainable tools are employed by workmen who have sufficient intelligence to make good use of them. The following quotation

from the Boston *Journal of Commerce* agrees with these remarks and cites the same facts in yet another light:

"There is an old saying to the effect that 'it takes a good workman to make a good job with poor tools.' So it does, and there have been many triumphs, recorded and unrecorded, of brain and skill over seemingly insurmountable obstacles. It is a satisfaction to compass a result with apparently inadequate means, and the mechanic who does it is justly proud of his success. But working with poor tools is never certain to produce good results, however great the skill and inventive the brain. Misses are made as well as hits, and even the most self-assured workman feels safer with good and applicable tools. No workman can afford to risk his reputation and success with poor tools; there is so much risk of a failure, and such anxiety for the result, that even if success is attained it has been at the expense of time, thought, muscle and trouble that robs it of half its gratification. The time has gone by when the workman was expected to 'make something out of nothing,' when one implement or appliance was made to do duty for another, and 'makeshifts,' their origination, use, and application to the job in hand were part of the kit of the workman. Even in hand tools the improvement is obvious to the slightest observation. In every department of industry these improvements have made their mark. They have saved time and labor and produce more satisfactory results. It is a wise economy to reject imperfect tools, and, as the patent-medicine men advertise, 'use the best. Whenever an improved implement is put into the market—one that will do the work better or quicker, it is economy to buy it, even if the old one is intact and serviceable."

TRAVELERS.—On spinning and twisting frames, short pieces of flat steel wire, bent to make almost a complete circle, but the ends do not quite meet. They are sprung upon the ring on which they travel around the bobbins; the threads to be spun or twisted passing through them on their way to the bobbins, and the tension upon the threads being largely governed by the weight or size of the travelers.

TREATMENT OF WOOL BEFORE CARDING.—Wool should be open and free to scour well; it is impossible to do justice to wool when submitted to scouring in the condition the sorters leave it in. Hot or strong scouring liquors are a decided injury to wool, but when too weak or too cold, wool is not got clean quick enough, and is consequently either scoured improperly or felted. Much hand-

ling while in any liquor felts wool. Sal Soda felts wool more than soda ash, soap more than sal soda, yet sal soda and soap *must* be used under certain circumstances. Many men cannot get wool through the squeezing rolls of a washing mashine from a perfectly clear water. The best temperature for scouring wool either by hand or machine is from 110° to 130° F. The chemicals used, the temperature of liquor and time of saturation should always be governed by the kind of wool in hand, and no attempt with a large lot should be made until a small sample has been got clean in a pail. By this method one soon learns to judge accurately by small experiments, a great saving. Tag locks and cotted wool should be subjected to a sweating.

TWEEDS.—Twilled woolen fabrics, at one time only those cassimeres with regular four-leaf twill, but now applied to almost any twilled goods resembling the original tweeds. English and Scotch tweeds differ in stock and character. The English goods of this class are usually finer than the Scotch. The finer grades are made of Australian, New Zealand, Cape, Buenos Ayres, Port Natal, German and Saxony wools. The coarser kinds or cheviots are made of Scotch, Slavonian, Chilian, Transylvanian and Colonial crossbred wools. Inferior wools from other countries are also used for this latter class. The wools of this country which give the best result in cheviots come from Maine. Canada wool does well also. It is necessary to spin this coarse stock twice to get it fine enough for many styles. Yarn dyed cheviots when the colors are fast enough to full a little, resemble the foreign goods much more than goods made of raw yarn. Crabbing improves the firmness of many pieces which would otherwise seem slazy. As a reliable work on Scotch tweeds that written by Robert Johnson may be cheerfully recommended. (The name is "Scotch Tweed Designers' Hand-Book.")

TWILLS.—Twills are fine diagonals of the plainest kind. Used largely in many woolen fabrics, and frequently employed as the ground texture of larger designs. In plain woolen goods the finer twills are used for light weight goods single, for heavy goods by adding a backing. In all materials the proportion, twist and size of yarn are important factors in the production of certain appearances of twills. If the warp and filling are the same size and twist, and the threads are equal in number, the filling will usually predominate, because it is almost impossible to weave the warp yarn as slack as the filling with the best tension devices. The warp yarn is generally twisted harder than the filling; therefore, if of the same

weight, and being woven tighter as well, the warp twill would sink in still more. To reverse this, the warp yarn may be made a little coarser than the filling, or the number of threads made greater. By making the direction of the twist conform to the direction of the twill, further effects are attained; the above statements are all made upon the supposition of like twist in both warp and filling, say right hand. If such yarn be woven into a twill running to the right, the twill will run with the twist of the warp and against the twist of the filling, consequently the filling twill will stand out more; if the twill be turned to the left, the warp twill will come up and the filling twill sink down. The warp being the hardest yarn, the goods in this case will feel softer when the filling predominates, the qualities and size of the yarn being the same. By reversing the twist of the filling and making it more prominent in that way the goods are made still softer, provided the stock in the filling is as fine or finer than the warp. For many goods, therefore, it is well to have the warp against, and the filling twist with the twill, for others the contrary may be better, and when the warp and filling are of the same twist, intermediate effects are produced.

Twist.—The amount and direction of twist, in yarn, plays an important part in fabrics; in the preparation of a design, in dissecting, and in the general management of a factory it should never be lost sight of or overlooked. The word twist is sometimes used instead of double and twisted yarn, manifold yarns, etc. In single or manifold yarn the evenness of twist is also important, but when unevenness of twist appears on the same bobbin it is usually the effect of uneveness in the size of the yarn, where it has either been strained by too much tension or was never drawn even. The twist runs to the finest places first and most.

Twitts.—Twitts in yarn are fine places that may be caused by irregular or excessive drawing. By overdrawing we mean drawing in some part of the process more than the stock will endure. Twitts may be discovered in yarn by taking a number of bobbins—say ten —laying them at one end of a sheet of paper, the color of which is a strong contrast to that of the yarn; draw the threads from the bobbins slowly over this sheet of paper, side by side, letting none cross others, and having them all about equal distances apart, not more than one inch at one end of the sheet, not less than one-sixteenth at the other. This is a very severe test for any yarn.

U.

Upland Cotton.—A species of sea island cotton produced in the inland counties of Virginia, the Carolinas, Georgia, Tennessee, Alabama, Louisiana and several other States. It is a light, weak and uneven staple. Of the various kinds of cotton, Baird gives some ten pages of most useful information.

Unit of Power.—One-horse power is by some writers given as the unit of power. "One-horse power is equal to 75 kilogrammetres." (Leroux's work.) Haswell says: "Its estimate is the elevation of 33,000 pounds avordupois one foot in height in one minute, and is nominated as being the nominal, indicated or actual."

Unsworth Needle Looms—The peculiarity of this loom consists of two sets of weft carriers and points in lieu of shuttles. The principle is employed on fringe looms.

V.

Velvet.—Velvet may be made in many ways; the plush may be of silk and the body fabric linen or cotton. When the material is all cotton the goods are called velveteen. The fabric, as it comes from the loom, before the plush is cut is most commonly known by the name of a class of goods of this order: "Fustian." The cutting, dressing and finishing processes are clearly described by Dr. Ure in his "Dictionary of Arts and Manufactures," from which the following and many other paragraphs in this work are quoted: "After the fustian cloth is taken from the loom-beam, it is carried to the cutter, who rips up the surface threads of weft, and produces thereby a hairy-looking stuff. After being thus ripped up, it is taken to the brushing or teazeling machine, to make it shaggy; after they are brushed in the machine the goods are singed by passing their cut surface over a cylinder of iron, laid in a horizontal direction, and kept red hot by a flue. They are now brushed again by the machine, and once more passed over the singeing surface. The brushing and singeing are repeated a third, or even occasionally a fourth time, till the cord acquires a smooth polished appearance. The goods are next steeped, washed and bleached by immersion in solution of chloride of lime. They are then dyed by appropriate chemical means, after which they are padded (imbued by the padding machine of calico printers) with a solutive of glue, and passed over steam cylinders to stiffen them. Smooth fustians, when cropped or shorn before dyeing, are called

moleskins; but when shorn after being dyed, are called beaverteen: they are both tweeled fabrics. Cantoon is a fustian with a fine cord visible upon the one side, and a satiny surface of yarns running at right angles to the cords upon the other side. The satiny side is sometimes smoothed by singeing. The stuff is strong, and has a very fine aspect.

Velvet Finish.—This term means a finish which has a resemblance to velvet. In woolens this finish is frequently required and consists of a short, thick nap standing up as straight as possible. This effect is produced by gigging almost equally both ways, and allowing no subsequent operation to lay down the nap.

W.

Warp.—The yarn which passes through the harnesses and reed. The character of this yarn should be altogether governed by the fabric for which it is to be used; but the product of a loom largely depends upon the strength of the yarn, be the fabric what it may. If for any reason the yarn of a warp is not strong enough for the work it must endure to produce the right texture, there is often a way open to change the texture slightly to relieve it with less damage than that caused by a small product and imperfect goods. Much may be done to humor a warp by various changes in the loom. When the warp is being woven very tight the opening of the shed is an extra strain upon the threads; if the shed is not at the right level this strain will be greatest upon one shed or the other. Sizing applied to warp yarn will make it work much better in many fabrics. This was at one time done altogether in the loom, but is now done by machinery while preparing the warps.

Warping.—The collection of yarn into a warp is a process seemingly very simple, but one which has brought out many new developments in machinery, and is still very imperfect in some particulars. The silk and cotton manufacturers have advanced far beyond the woolen in this department. This may be accounted for by the fact that no subsequent process with them will hide the defects in warping, while in woolen goods the shrinkage and the nap have covered and must to-day cover many sins. The manufacturers of worsted goods have of late turned their attention in this direction; and well they may, since nearly all the requirements of cotton warps hold good in relation to worsted, and the finish is

such as can not be depended upon to conceal anything. Even tension in all parts of the warp, equal length of all the threads, and even dressing when applied, are the three great requisites of warping. Other important points will intrude on every hand, but none assume the importance of these. In silk and cotton it is now the common practice to put the yarn upon separate beams, from the small bobbins or spools, then to take alternate threads from these beams, from four to twelve in number, for the warp. The machinery, especially that for applying the sizing or dressing, and for drying the same, is now very perfect. These machines, or modifications of them, are being introduced for worsted work, and are really a necessity. The manner of warping woolen warps is still very primitive in many mills, and the best machines in use are not what they should be, because manufacturers will not pay the price of better ones. A greater folly can hardly be found in the entire manufacturing interests than this. The warp being well prepared, good work and plenty of it is a natural consequence—the opposite side is too ridiculous to mention. The necessary remedy lies principally in better machinery, (manufacturers should do their utmost to stimulate development;) next in more pains and labor with what machinery is now in use. In warping for fancy goods the number of threads are fixed by two limits—the pattern and the weight, both of which must sometimes be modified to bring them within present facilities for warping. Whether the warp is made from section beams or in sections upon a reel, the first calculation necessary is to find the number of threads in each section, and if possible make them conform to the threads in a pattern. That is, the threads of a section should be a multiple of the threads in a pattern. Making several different sized sections, or running one straight, the next reversed, (with a twist,) are almost sure methods of making section stripes; the matter of damage is only doubtful when there is a question whether the kind of goods happen to show them or not. Having found the threads of the sections in conformity to above instructions, the number of patterns per section will necessarily be known; the number of threads of each kind of yarn per section is now obtained by multiplying the number of each kind of threads in a pattern by the number of patterns per section; the total number by multiplying this product by the number of sections, and the total amount of each kind of yarn in yards by multiplying the last product by the length of the warp in yards. To ascertain the weight from the yards, see Yarn Table and Rules. For dressing or sizing, see Sizing.

Waste.—Too much attention cannot be paid to the matter of waste in a factory. Not only waste of material, yarn and cloth, but time and supplies. The manner of assorting, preserving and packing waste is of importance. To keep the waste clean it must be kept off the floors as much as possible, what falls to the floor should be picked up, not swept along with other sweepings.

Waste Pickers.—The many machines under this name made to pick or ravel waste to recover as much staple fibers as possible from refuse yarn, need little comment. The Kitson & Parhurst pickers for the purpose are well known, and probably have the lead in the market.

Weaving.—Such elaborate articles on this subject may be found in the opening chapters of nearly all books on Weaving and Designing that it is superfluous to add to or repeat what has been thus published at the present writing.

Weft.—Filling.

Weights.—The convenience of standard weights of all kinds, as well as many special weights, for test weighing and the like, is a subject beyond comment. The surest way to get accurate weights is to have them made by responsible parties, who are provided with the exceedingly sensitive scales necessary to test weights. With care and patience very good weights may be made. Baird gives instructions (pp. 192) that the amateur in the manufacture of weights will do well to heed.

Willowing.—This process is one that comes under the head of separating the staple from refuse matter. It is practised very generally by the best woolen mills. The cotton gin serves the best purpose for cotton, but has more to do and under greater difficulties. In further cleansing stock, each kind of textile fiber must be treated differently in the early cleansing processes. That which interests the most men, because they are engaged in that branch, is wool washing and scouring, and perhaps there is no other staple so troublesome from the many variations required.

Winding.—By winding we understand that a process similar to that of spooling is implied, but that the receptacle of yarn in this case is a bobbin, not a spool. Much that may be said of spooling applies here, especially the allusions to precaution; good work in winding is more imperative, because a badly wound bobbin cannot be used without loss of time and material, particularly in the shut-

tle, the most common destination of a bobbin of yarn. In winding bobbins great care should be taken to adjust the machinery to form the taper to suit the peculiarities of the yarn wound. For instance, slippery yarn should have a long taper, tender woolen yarn a short one, and in all cases should the guide which forms the taper work smoothly and regularly. The tension should be so applied that the yarn will draw a little harder when winding next to the wood than when at the large end of the taper; few machines will do this, but it is a point of great advantage. There should never be a dwell in the guide motion, or an irregular traverse, as the yarn will certainly come off with irregular tension if this is not attended to. The faults of and remedies for over-run, too full, large, hard or soft bobbins are obvious. In some parts all spools and bobbins are given this one name, but in this country the term bobbin is now almost universally applied only to a barrel with one head. Bobbins should be made of wood which wears smooth, whatever the first cost. Maple is very good. Steaming yarn on the bobbin is very destructive of the bobbin, however much it benefits the yarn. Setting the twist by heating in an oven is quite as bad for wood; when either course is practiced many bobbins are split. Of the shape of bobbins little can be said save that the bobbin should be made to suit the yarn. Cone bobbins are those which have a cone next to the head, because the building motion upon the machines used for winding the yarn upon the bobbin requires it; the same requirement usually extends to the shape of the cone. Ribs or depressions, or creases upon the barrel, prevent the yarn from sliding off in a body, but the rib adds considerable friction and consequently cannot be used on some kinds of work, the difference in the tension of the yarn when beginning to unwind a bobbin, and at the last being too great.

WOAD.—The plant (*Isates Glastumn or Isastis Tinctoria*) when made into fermented paste is known as woad. It is a native plant of England, its coloring properties having been used by the ancient Britons more than 2,000 years ago. It is also cultivated in Europe. Its use in the blue vat is very important and requires much skill and experience. The nature and application of this substance should be studied by all who should understand colors, their nature, peculiarities and relations.

WOOL.—Wool, strictly speaking is a cutaneous secretion taking place through the epidermic pores of the animal. These pores are all of the same diameter, and, at equal intervals upon the epidermis

of the same sheep. They vary according to species, and are narrow, straight or tortuous, and, consequently, the wool fibers will be fine, smooth or undulating, according to the shape of the pores by which they are gauged. Wool, if kept in a well-ventilated place, undergoes very little change. Under the influence of heat, wool decomposes, giving carbonate of ammonia and much oil. Acids act but feebly upon it; caustic alkalies and their solutions dissolve it entirely. Wool is classified and valued by the length of its staple, the diameter of its fiber, its suppleness, elasticity and strength. The fineness of wool is determined by the number of undulations in a given length of staple—a very wavy staple should double its length by stretching, and then return to its original dimensions. There are two principal sorts of wool, namely: short or carding wool and long or combing wool. These two sorts give rise to four very distinct classes:

First—Fleece wool for combing;

Second—Fleece wool for carding;

Third—Pulled wool (mortling) for combing;

Fourth—Pulled wool (mortling) for carding.

Fleece wool is all that is shorn from the living animal; and pulled wool (pelt wool, mortling), that pulled from the skin of the animal after death. The latter is less valuable than the former. These two sorts differ in their stoutness and softness. Both are generally white, though sometimes black or brown. The skins supplying the pulled wool are of two classes:

First—The skins of animals killed on farms.

Second—The skins of animals killed in slaughter houses.

According to its degree of fineness pulled wool is sorted into fine, medium and common. This kind of wool, never having reached maturity, and, moreover, being weakened and impaired by the lime used in stripping the skin, is lighter and weaker than fleece wool.

Woolens.—The term woolens is used by the trade, and includes as a class, all woolen goods for men's wear, flannels, etc., etc.

Worsted.—The essential difference between worsted and woolen yarn is that the former is combed, the long fibers being all laid parallel, the short fibers separated and taken away, while in the latter the fibers, long and short, must go together, and they cannot be so thoroughly straightened out. The reduction of the sliver or tops, as it comes from the combs to yarns, is also different from the process of spinning woolen yarn. The stock must, of course, be suitable to the process, hence the wools that are long and strong

enough to produce good worsted yarns are graded into combing and delaine wools. Unless the drawing is done on machines that do not twist the slivers, and the spinning on a very long draught machine like the mule, the yarn will be hard and wiry, lacking elasticity. This is the disadvantage the English process in the manufacture of worsted yarns has over the French. Having produced the right yarn, the production of the texture is similar to other goods, but far more trying to the weaver; because of its costliness, the necessity of avoiding the smallest imperfection becomes imperative, and on account of the peculiarity of the fabrics every imperfection is easily seen. The process of finishing and dyeing worsted goods is far more difficult than any one unacquainted with the nature of the difficulties can imagine. The treatment of a few kinds of worsted fabrics from the loom to the case would be a capital subject for a large book.

X.

XERGA.—A Spanish name for a peculiar woolen blanket. Our common market term, " Serge," is derived from this name.

Y.

YAMA-MAÏ, OR OAK TREE SILKWORM.—The Yama-maï is a species of silkworn common in Japan, which derives its sustenance from the leaves of oak trees.

YARN.—Any spun thread may be called yarn, but the term in its strictest sense implies spun wool.

Uneven Yarn.—The causes of uneven yarn are numerous and varied, the consequences invariably imperfect goods, almost always a reduction of product, and much waste. There are a variety of terms used to designate the kind of unevenness. What is understood by uneven yarn, is that caused by uneven stock or roving, tight or loose bands, worn drawing rolls, etc., etc. Uneven twist is often mistaken for uneven yarn, but by careful weighing one may ascertain which it is. The uneven twist when not caused by irregular size or tension of spindle bands is usually the effect of irregular tension between the roving spool and the yarn bobbin. To watch every set of bobbins as they are taken off is an important duty that some one who is competent should be entrusted with.

Twitty yarn may be caused by poor carding and combing, improper adjustment of drawing rolls, uneven speed, slipping belts, etc., etc. If the stock in the roving is examined frequently there should be no difficulty in deciding whether the trouble is in the spinning or before. The spinner cannot make good yarn with poor roving or machinery which is not adapted to the work.

YARN NUMBERS, OR COUNTS.—The numbers of woolen yarn most commonly used in this country are those regulated by the run and grain systems. By the run system, No. 1, or 1-run yarn, has 1600 yards per pound; No. $2\frac{1}{2}$, or $2\frac{1}{2}$-run yarn, has 4000 yards per pound, etc., etc. This is very convenient, because so easily estimated per ounce, each number representing the number of times 100 yards are needed to weigh an ounce. The grain system of numbering woolen yarn is quite different, the most common measure or basis being 20 yards. Whatever 20 yards of any kind of yarn weighs in grains is the number given by this system. If 20 yards of any yarn weighs 13 grains, it is called 13 grain or No. 13 yarn; if the same measure weighs 30 grains, then the yarn is designated as 30 grain or No. 30 yarn.

YARN TABLES AND WEIGHTS.—The avordupois pound and ounce are the correct weights for yarn calculations, but finer denominations are necessary; the pennyweight and grain of the Troy weights being convenient, they are sometimes employed in expressing smaller divisions of an avordupois ounce.

24	grains	=	1	dwt.			
$437\frac{1}{2}$	"	or	$28\frac{11}{48}$	"		=	1 ounce.
7000	"	"	$291\frac{2}{3}$	"	or 16	"	= 1 pound.

Table of Common Fractions of Ounces in Grains.

$\frac{1}{100}$	of	1	ounce	= $4\frac{3}{8}$	grains.
$\frac{16}{840}$	"	1	"	= $8\frac{1}{3}$	"
$\frac{16}{560}$	"	1	"	= $12\frac{1}{2}$	"
$\frac{1}{10}$	"	1	"	= $43\frac{3}{4}$	"
$\frac{1}{5}$	"	1	"	= $87\frac{1}{2}$	"
$\frac{1}{4}$	"	1	"	= $109\frac{3}{8}$	"
$\frac{1}{3}$	"	1	"	= $145\frac{5}{6}$	"
$\frac{1}{2}$	"	1	"	= $218\frac{3}{4}$	"
$\frac{2}{3}$	"	1	"	= $191\frac{2}{3}$	"
$\frac{3}{4}$	"	1	"	= $328\frac{1}{8}$	"

If $\frac{1}{100}$ of an ounce or $4\frac{3}{8}$ grains are put into one shell of a balance scale, the number of any woolen yarn in runs may be ascertained by the number of yards it takes to balance the $4\frac{3}{8}$ grains.

12

For the grain system of numbering woolen yarns the weight of 20 yards of any yarn in grains being used as the number of the yarn, all that is required is a good scale and set of grain weights to ascertain the number.

For cotton yarn use $\frac{16}{840}$ for an ounce or $8\frac{1}{3}$ grains and for worsted yarns use $\frac{16}{560}$ of an ounce or $12\frac{1}{2}$ grains to ascertain the number of the yarn.

Worsted and cotton numbers for yarns are derived from the number of hanks required per pound, but the size of reel used differs, therefore, the number of hanks per pound must be different. The cotton reel is taken at 54 inches in circumference, the worsted reel at 36 inches or 1 yard for a basis.

Cotton Table.

54 inches=1 thread=$1\frac{1}{2}$ yards.
80 threads=1 lea or knot=120 yards.
7 leas or knots=1 hank=840 yards.

Worsted Table.

36 inches=1 thread=1 yards.
80 threads=1 lea or knot=80 yards.
7 leas or knots=1 hank=560 yards.

Some woolen mills number their yarns by cuts. The number given indicates the cuts per pound:

Two hundred and forty yards per cut.

Eight cuts per head.

Six heads per spindle.

Street's tables for grading yarns are highly recommended.

F. T. Ashton of Pittsfield, Mass., publishes a Spinner's Guide, well thought of by many, for yarn calculations.

The following tables are very convenient for those who must make comparative estimates of yarns numbered by the different systems.

YARN TABLE.

Weight of 20 Y'ds in Grains.	Yards.	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000
	Holes.	16.66	33.33	50.00	66.66	83.33	10.00	11.66	13.33	15.00
	Runs.	.625	1.25	1.875	2.50	3.125	3.75	4.375	5.00	5.625
87.50	1	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00
70.00	1¼	8.00	16.00	24.00	32.00	40.00	48.00	56.00	64.00	72.00
58.33	1½	6.66	13.33	20.00	26.66	33.33	40.00	46.66	53.33	60.00
50.00	1¾	5.71	11.42	17.20	22.91	28.62	34.33	40.11	45.82	51.53
43.75	2	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00
38.88	2¼	4.44	8.88	13.33	17.77	22.22	26.66	31.11	35.55	40.00
35.00	2½	4.00	8.00	12.00	16.00	20.00	24.00	28.00	32.00	36.00
31.81	2¾	3.63	7.27	10.90	14.54	18.17	21.81	25.44	29.08	32.72
29.16	3	3.33	6.67	10.00	13.33	16.67	20.00	23.33	26.67	30.00
25.00	3½	2.86	5.71	8.57	11.42	14.28	17.14	20.00	22.84	25.71
21.87	4	2.50	5.00	7.50	10.00	12.50	15.00	17.50	20.00	22.50
19.43	4½	2.22	4.44	6.66	8.88	11.11	13.33	15.55	17.77	20.00
17.50	5	2.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00
15.90	5½	1.81	3.63	5.45	7.27	9.08	10.90	12.71	14.54	16.35
14.57	6	1.66	3.33	5.00	6.66	8.33	10.00	11.66	13.33	15.00
13.45	6½	1.53	3.07	4.61	6.15	7.69	9.22	10.76	12.30	13.84
12.50	7	1.42	2.85	4.28	5.71	7.14	8.57	10.00	11.42	12.85
11.66	7½	1.33	2.66	4.00	5.33	6.66	8.00	9.33	10.66	12.00
10.93	8	1.25	2.50	3.75	5.00	6.25	7.50	8.75	10.00	11.25
10.28	8½	1.17	2.35	3.52	4.70	5.88	6.05	8.23	9.40	10.58
9.71	9	1.11	2.22	3.33	4.44	5.55	6.66	7.77	8.88	10.00
8.75	10	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00
7.95	11	.90	1.81	2.72	3.63	4.54	5.45	6.36	7.27	8.18
7.28	12	.83	1.66	2.50	3.33	4.16	5.00	5.83	6.66	7.50

Some years ago the author published the above yarn table. It has since been published by several other parties, which is sufficient evidence that the table is worth the space it occupies here. It is not convenient to any one who is not in the habit of using decimals in calculations of this kind. But to any one who has become thoroughly conversant with the convenience of the decimal point, it will be of great service in estimating stock required, yarns, spooler measures, etc. It is applicable to both the run and grain systems of numbering, and by using other tables of this work for comparison of numbers it will answer tolerably for worsted also. The original explanation of the table is also given:

"The yarn table herewith is intended to cover several points. First, to find the weight in ounces of any number of threads, one yard in length, or, in other words, any number of yards of yarn. Second, to find the measure in runs; and, thirdly, in holes, of any number of yards. The size of the thread being designated both in grains and runs, in the two first columns. The yards in the first line, holes in the second, runs third, and ounces in all subsequent. The yards are given in thousands, for convenience sake; for a less

number it is only necessary to divide by ten, one hundred, or one thousand, as the case may be, by removing the decimal point to the left one, two or three spaces. The table is based as follows: 100 yards of one-run yard weigh one ounce; 1,600 yards or one run in length weighing one pound; 60 yards one hole."

Z.

Zig-Zag.—In some parts, particularly in England, herring bone textures are called by this name. The texture effects which the writer classes as zig-zags are those in which the twills reverse in a much more irregular order. One sometimes meets muslins and gauze of this class, reminding one of chain lightning.

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To the Subject Matter of the Manual which is not Alphabetically Arranged.

Note.—The work contains 162 pages of names and terms with definitions and derivations, also elementary instructions on many important subjects involved. all arranged in alphabetical order.

APPENDIX.

APPENDIX.

Achromatic.—Not showing color caused by the decomposition of light.

Achromatic Lens.—A lens composed of separate lenses of different shape and substance, with the necessary adjustment of curvatures to correct the chromatic aberration in each by the other.

Achromatic Microscope or Telescope.—Instruments in which the achromatic or compound lens is employed for the object glass.

Burling.—The real process of burling involves nothing further than the removal of burrs from the woolen cloths, at a proper or convenient time during the finishing process. When burrs exist in great numbers, and the character of the goods permit, they may sometimes be satisfactorily removed by means of a chemical process. Nearly all fabrics require more or less burling. This is done by hand, and, as it would be a waste of time and labor to do otherwise, the burlers are expected to remove knots, lumps, slubs, etc. Upon careful, thorough and skillful burling many kinds of goods depend for a perfect appearance when finished. Goods may be such as to require the burling and removal of knots after washing—for instance, in many light worsted fabrics if a knot is removed before washing, the ends of the threads will shrink back; again, some goods need to be burled several times; in others some lumps, knots, etc., may be left in, for the fine-drawer to remove when ready to repair the damage, while others may be left in, until removed by some other operation like gigging or shearing.

Delaine.—A light worsted fabric. The wool for these goods having been for a long time especially selected as to quality, length and strength, has given that class of wool the appellation "Delaine Wool."

Extractors.—The use of extractors in factories is very important, whether the water is thrown or squeezed out; all woolen fabrics especially should be thoroughly extracted before drying. The machines which throw out the water have one great advantage over those which squeeze it out, when cloth is extracted, viz., the

open state of the fabric produced. The pressure of squeezing rolls compresses the goods and makes them more impenetrable to currents of air necessary to dry them. The extractor of the day for cloth, is no doubt the new one recently introduced by the Tolhurst machine company of Troy. This machine throws the water from the goods, which are put into the machine upon a roll, thus saving much labor, and doing the work better than any other kind. Extractors for wool rags and the like must still retain the old principle — a basket revolved at high speed.

Fine Drawing.—Fine drawing literally means drawing fine threads into fabrics to repair damages. The fine drawer should have a thorough comprehension of the texture in hand to do good work; this at once involves a mind superior to that found in the more ordinary working people; also skill and judgment, all of which necessitate the payment of high wages for this work. Real fine-drawers of experience are hard to find in this country, consequently the work is largely left undone or poorly done. While this is wrong, and the education of good fine-drawers should interest every manufacturer because of the saving they would prove, it must not be supposed that the presence of any number of fine-drawers in any mill would make a greater leniency in other departments practicable. On the contrary, prevention is ever better than cure, and in most instances in the factory, infinitely cheaper. The fine-drawer may save many times his or her wages in repairing unavoidable damages in the most ordinary goods, but it is ruinous to provide fine-drawers with more than this to do.

Genappes.—"A worsted yarn, subsequently to spinning treated to produce upon the thread a smooth, lustrous and fiberless surface."

Ink.—The subject of ink is of no little importance to the designer, if he would produce neat, clear and distinct drafts with the greatest ease possible. The same specifications apply as in mechanical drawing. Good indelible inks are indispensable for the best work.

Jacquard.—The Jacquard is a loom, parts of which were invented and improved by a noted Frenchman of the same name. Many improvements upon the original have been made. The sheds are opened by means of wire hooks of exactly the same form as those used in the witch machine, but are more numerous in the Jacquard machine. The hooks are placed in eight rows, (this varies according

to the extent of the machine which is known in trade as the 400-machine—that is, a machine containing 400 of these hooks for the purpose of making patterns, and eight of which are sometimes used for selvages or other purposes.) Each of these is supported or kept in position by a cross-wire, having an eye through which the hook passes. One end of this wire is kept perfectly straight, while on the other end is formed a loop; the straight end is passed through a perforated board called the needle-board, and is allowed to project about three-eighth of an inch in front of it; the loop end is secured by a wire pin passed down through it. Immediately behind this is placed the spring box, which contains as many small helical springs as there are cross-wires, and which are so arranged that each one acts upon the loop at the end of the cross-wire. The pressure thus bestowed upon the cross-wires keeps them in position through the needle-board, and at the same time keeps the hooks in an upright position. To the bottom of the hooks is attached a cord termed the neck-cord; this cord is passed down through the bottom board of the machine upon which the hooks rest. At a distance of a few feet from the bottom of the machine, and a short distance above the warp line is placed another perforated board, known as the cumber board. These holes are at regular distances, in rows of eight, the distances apart being arranged according to the number of ends per inch required in the cloth. The board is divided into divisions of as many holes as there are hooks in the machine. Taking the first hook in the machine a cord is passed down from it and through the first hole in each division of the number board. The second hook is treated in like manner, and so on, until every one of the four hundred hooks have as many cords attached to them as there are divisions in the cumber board Each of these cords has, at the warp line, a mail, through which the warp passes, and which answers the purpose of the heddle; to the bottom of each cord is attached a lead or wire weight for the purpose of bringing it back into its place after being lifted to form a shed. Every cord in each division being each a repetition of the other. This four hundred, then, represents the limit of the number of ends upon which a pattern can be produced. It has been shown that the cross-wires are allowed to project in front of the needle-board. From the top of the frame depends an arm, which carries a square perforated bar, or, as it is termed, a cylinder. In this cylinder the holes are bored to correspond in position with the needle-board, but the holes are larger to allow the needles to enter them easily. It will be apparent that if this cylinder be brought in contact with the points

of the needles which project through the needle-board no effect would be produced, because each needle would enter a hole, the springs in the box keeping them in position ; but if any of the holes in the cylinder are stopped, it immediately strikes back the needle, the spring giving way under the pressure ; the result is that the upright hook is pushed back out of position over the lifting blades. These hooks are fixed in a movable frame, and their duty is to lift such of the hooks as are not pressed back in the manner described. The way in which the pattern is formed is by having a number of cards cut to the desired pattern and passing over the cylinder. At each tread or pick of the loom, the arm is thrown back, and all the needles are liberated. Then, as the shed closes, the cylinder again comes forward with the card upon it, and presses back such of the hooks as are not required to be lifted for the pattern which is being woven. To insure the cards following each other in the proper order, they are fastened together in a continuous chain, by means of string laced through holes cut for that purpose at each end and in the middle. The preparation of the cards is an important process, requiring a great amount of experience, skill, care and attention. The first thing that is necessary is that the design should be drawn, on an enlarged scale, upon squared paper, which is intended to represent the warp and weft. This being done, it is taken before the card cutter, placed between two laths, in such a manner as to leave in view the line which represents the pick of weft he is about to cut the card for. He places a punch in every hole of the plate corresponding with the white space upon his paper. The card and plate are then placed in the stamping machine and the card cut. After one set of cards has been cut from a design, any number may be repeated by means of the repeating machine. The cards are all numbered in the order in which they are cut from the design, put upon a frame to keep them in proper position in consecutive order, and laced or strung together as previously described. All this work is now largely done with machinery.

Within the last thirty years the Jacquard apparatus has undergone numerous modifications, not only to make it more efficient but to adapt it to particular descriptions of weaving. It has also been successfully applied to the lace frame, and to several purposes apart from weaving, such as musical instruments, to punching machines for punching wrough-iron plates used in the construction of girders, and to type-setting machines. To increase the speed of the apparatus, and to make it more adapted to the power-loom, rising and falling motions have been given to the bottom board of the machine,

as well as the griffe and the double action principle for increasing speed is gradually working its way. A great improvement has also been made by working the card cylinder by a connection which can be detached, which not only operates advantageously for the action of the griffe on the hooks, but enables the weaver to reverse the cards or "pull back" with ease and certainty. Even electricity has been applied for operating on the needles, but this idea, although workable, can scarcely be considered in any other light than as a novelty. Since the power loom became thoroughly established the improvements in it have been so great and varied that we can at present merely indicate their nature. In the loom itself the take-up motion and weft stop motion have been much improved. Shedding motions, for the production of small patterns, have been very numerous, and many of them very ingenious. Circular and drop boxes have also received great attention, in order to adapt them to the increased speed of the loom, which is now at least twice as fast as in the early days of the power loom weaving. These boxes are for the purpose of weaving checks, or goods which require different colored or different kinds of weft. Swivel, carpet, velvet and other descriptions of looms, in combination with Jacquards, have also received great improvements.

Lamps.—For night work in the designing-room good light should be the first consideration. This can only be obtained when the flame from which the light is delivered is large, intense and steady. Many design-rooms have gas light, which is very good when the gas and burners are good and the pressure even; but many must work where gas is not available; for such the best coal oil lamp is the next best to a good gas jet, unless the electric light is made available. But none of these will without the aid of reflectors and condensing lenses prove sufficient to illuminate an object under a microscope, or a sample to be dissected. Well directed light is needed.

Lenses.—Many kinds of spare lenses are very convenient in a designing-room. A set of cheap lenses of the various forms, viz.: Double Convex, Double Concave, Plano Convex, Plano Concave, Meniscus Convex and Meniscus Concave should be possessed by all. A few larger Plano Convex lenses may be used to good advantage as condensers for special illumination. Especially does the designer need colored lenses, to test, correct and suggest new shades and tints of colors. These are not expensive; with them costly experiments are often avoided. Even solid sombre colors can be advantageously examined and correctly criticised by their use.

Magnifying Glasses.—A good magnifying glass is often very convenient, while it does not permit the scope of powers and focus that a single microscope may, it has the advantage of being always ready for such work as can be done with it. For dissecting they are undesirable for many reasons; the microscopes for the purpose are more steady, reliable and can be adapted to various kinds of work. Single lenses are objectionable in nearly every kind of instrument used by the designer, the achromatic lenses are needed to discern colors correctly.

Microscopic Objects.—A large collection of well-mounted objects, like and similar to objects which should be frequently examined are of inestimable value. They serve as a base of operations for nice and important comparisons.

Mounting Materials.—The necessity of mounting materials in the designing-room, or office of every first class factory, arises from the fact that a well-mounted microscopic object may be preserved for any length of time; it requires little space and usually proves more valuable for future reference and comparison than pages of memorandums or drawings.

Parcel Pens.—This name was given these pens because they were intended by the inventor for marking parcels. The designer finds for these, a set of good shading pens, and the triple pointed pens, a much more important use. By choosing a pen of the right width, either the parcel pen or a good shading pen, will fill an entire square of the design paper with one stroke. Thus these conveniences may be used to beautify as well as lessen his work.

RECEIPTS.

Cements.—*Rust Joint*—(Quick Setting.)—One pound Sal-ammoniac, 2 pounds Flower of Sulphur, 80 pounds fine Iron chips. Made to a paste with water.

(Slow Setting.)—Two pounds Sal-ammoniac, 1 pound of Sulphur, 200 pounds Iron borings.

The latter cement is best if the joint is not required for immediate use.

For Steam Boilers, Steam Pipes, etc.—(Soft.)—Red or white lead in oil, 4 parts; fine Iron chips, 2 to 3 parts.

(Hard.)—Fine Iron chips and salt water, and a small quantity of Sal-ammoniac with fresh water.

For Holes in Castings.—Sulphur in powder, 1 part; Sal-ammoniac,

2 parts; powdered Iron turnings, 80 parts. Make into a thick paste.

The ingredients composing this cement should be kept separate, and not mixed until required for use.

To Mend Iron.—Sulphur 2 parts, fine Black Lead 1 part. Put the sulphur in an iron pot, over a fire, until it melts, then add the lead; stir well; then pour out. When cool break into small pieces. A sufficient quantity of this compound being placed upon the crack of the ware to be mended, use a soldering iron as in brazing.

For Cisterns and Casks.—Melted glue, 8 parts; Linseed-oil, 4 parts. Boiled into a varnish with litharge.

This cement hardens in about 48 hours, and renders the joints of wooden cisterns and casks air and water tight.

INKS—*Indelible, for Marking Linen, etc.*—1. Juice of Sloes, 1 pint; Gum, half an ounce.

This requires no "preparation" or mordant, and is very durable.

2. Nitrate of silver, 1 part; Water, 6 parts; Gum, 1 part. Dissolve.

3. Lunar caustic, 2 parts; Sap green and Gum arabic, each 1 part. Dissolve with distilled water.

The "Preparation."—Soda, 1 ounce; Water, 1 pint; Sap green, ½ drachm. Dissolve and wet the article to be marked, then dry and apply the ink.

A Permanent Ink for Stones, Marble, etc.—Pitch, 11 parts; Lamp-black, 1 part; Turpentine sufficient. Warm and mix.

Copying Ink.—Add 1 oz. of Sugar to a pint of ordinary ink.

SPECK DYE for cloths with cotton warps and mixed filling (cotton and wool).

	Pounds.
Extract Logwood	100
Soda-ash	77½
Blue Vitriol	43
Extra Citron	6

Make in 100 gallons of water; reduce to strength desired. This will tint white wool.

Another which is safe to use on cloths which have fancy woolen threads, 100 gallons of water.

	Pounds.
Logwood (extract)	62
Soda-ash	30
Blue Vitriol	15

For specking ink use some good indelible ink which dries quickly. A little gum arabic hastens drying. A good printer's ink thinned down with benzine is good also.

To Remove Stains.—Stains of iodine are removed by rectified spirit. Ink stains by oxalic or superoxalate of potash. Ironmolds by the same: but if obstinate, moisten them with ink, then remove them in the usual way. Red spots upon black cloth from acids are removed by spirits of hartshorn, or other solutions of ammonia.

Stains of Marking-ink, or Nitrate of Silver.—Wet the stain with fresh solution of Chloride of lime, and after 10 or 15 minutes, if the marks have become white, dip the part in solution of Ammonia or of Hyposulphite of soda. In a few minutes wash with clean water. Or, stretch the stained linen over a basin of hot water, and wet the mark with tincture of iodine.

To Remove Iron Mold.—Remoisten the part stained with ink, if possible the same kind as that in the stain; remove this by the use of muriatic acid diluted by 5 or 6 times its weight of water, when the old and new stain will be removed.

Cleansing and Scouring.—While Job Dyeing is not a subject proper for this book, it involves many points which manufacturers would do well to heed; to prove this assertion we quote from "The Dyer and Scourer" a few remarks on scouring as practised by "job dyers":

"The object sought for in scouring operations is, or should be, the thorough cleansing of the goods under such treatment. Unfortunately, however, many persons, either from ignorance or carelessness, fall far short of attaining the desired end. More especially is this liable to be the case with the "jobber;" and for this reason, and also because of the peculiar nature of some of his work, we propose to devote a little space to this important subject. And we will first consider the treatment of such goods as are for cleaning only, because, in our humble opinion, such articles should receive the undivided attention of the workman, should be scoured as expeditiously as possible, and removed to the drying room at once. Of course, for all scouring purposes, rain water, by reason of its freedom from mineral or earthly matter, is preferable; but owing to the large quantity necessarily consumed in these operations, and the uncertainty of the supply, the workman is reduced to the necessity of using spring, river or other water, all more or less contaminated with these impurities, the presence of which is the prime cause of his failure.

It is of paramount importance that the scourer's soap should be of good uniform quality, and that he should use it of uniform strength. To secure these desirable ends, he will, in the first place, deal only with good, reliable makers, and, secondly, will dissolve a given weight of soap in a known quantity of water. He will also do well to see that the soap used for the class of scouring now under consideration is of a neutral character, and is *always used cold*, thus lessening the chances of bleeding the colors in the goods treated.

We will now proceed to scouring of men's clothes. We first beat out, or brush off, any loose dirt, and turn out the dirt from the pockets; then make up a good substantial soap liquor in the punch-tub, and, entering the goods, punch them well for ten or fifteen minutes, occasionally turning them over.

We now fold each article as flat as possible, taking care to turn the buttons inside, and pass through the wringer. This squeezes out the dirty soap, and leaves the goods in a better condition for the next liquor, which should only be of sufficient strength to *fill* them, or, in other words, to make a good lather in them, which can be ascertained by squeezing in the hand, when, if they have sufficient, it will come to the surface and remain. We again put through the wringer, and then punch in another liquor, with just sufficient soap added to raise what (in the language of the dye-house) is termed a bead, or, in other words, enough to create and support bubbles on the surface. This liquor takes the soap from the goods, and causes them to come clear from the rinse. The reason for this is that before a bead can possibly rise to the surface of this weak liquor, enough soap must be added to combine with or neutralize the whole of the impurities in the water, leaving the latter *soft*, and free to appropriate the soap in the goods. After working in this a short time, we find it getting quite frothy and strong; we then lift the goods and add more water, taking care not to entirely knock down the bead. We punch in this again, occasionally adding water, until the soap is all drawn from the goods, which is known by squeezing them and by the poorness of the liquor. They might even be dried at this stage, but to make assurance doubly sure we proceed to rinse them in two separate waters at about 100° Fah., and from this if all woolen—pass them through cold water with just sufficient sulphuric acid in it to be appreciable to the taste, and finally put them in the "salt hardening." After laying a short time in this, we take out and extract all the water possible, either by means of the "hydro extractor," which is best, or the wringer, which last should have rubber rollers. Upon reaching the stove or drying-room we

pull or stretch any that we think likely to have shrunk a little, and then hang the whole up to dry by putting each article on half a wooden hoop suspended from the center. The object in passing through the acidulated water is three-fold. It kills whatever traces of soap still remain; it clears up such goods as greys, checks or anything containing white; and raises or brightens such as are mixed with yellow, orange, scarlet, blue, green and kindred colors. It is contended by some dyers that goods containing drabs, fawns, browns and other wood colors are injured and their color changed by this use of acid; but we have found from long experience that, used in the proportion above named, it has the effect of restoring these colors to their original shade previous to scouring, for, let this operation be conducted ever so carefully, the soap will to a certain extent affect them, and that in a directly opposite manner to the acid, which in this case merely neutralizes the effects of the former. The salt hardening is for the purpose of preventing the colors from running, or rather for fixing them, and is made by merely adding one pound of common salt to every thirty gallons of cold water. This is the proper treatment for nearly all woolen goods, and, with trifling modifications, mixed goods also; although some of such, owing to the ease with which they *bleed*, should be cleaned singly by hand, as they are thus put through more expeditiously.

In the cleaning of silk we substitute a large board and a brush for the punches, and keep the articles as flat and free from creases as possible. This is to avoid the crushing or breaking of the silk; which, owing to its peculiar close texture and stiffness, would inevitably follow were we to treat it in the usual way; and which, moreover, no amount of subsequent dressing or finishing would effectually remove. The best plan is to have the pieces composing dress or other articles tacked into a compact sheet or strip, which can be handled and folded over readily. We give the soaps as for woolens, but we *do not punch*; on the contrary, we brush and handle these goods through all the liquors as carefully and straight as possible. Neither do we *wring*, because in the first place, it is not necessary, silk holding so little soap; and, secondly, because it would break and injure the silk. To get the water from such goods previous to hanging up, we either place in the "extractor," or spread flat on a sheet, and rub down smoothly with clean white cloths. Some silks, having a peculiar, sensitive or fugitive top given them in the dyeing for producing a particular shade, such, for instance, as some apple-greens topped with picric acid, dark browns topped with indigo compound, and others will, in spite of the

utmost care, lose some of this surface color; and in some cases it will be found necessary to pass such through a *weak warm* bath *of the lacking* dye. * * * * *

In preparing goods that are, for the most part, badly soiled and faded, for dyeing, our aim is not only to clean them but also, with some exceptions hereafter noticed, to bleed or strip them, and thereby leave as little of the old color as possible.

We first select the white or light-colored articles, and proceed to punch them in a strong soap at a temperature of about 110° Fah., having a little ammonia or other alkali in solution. When this appears dead, or fails to lather up, we wring out and give another soap, as before—omitting the alkalis, however. Then follows the weak, or thin soap liquor, as described previously, only that in this case it is used quite warm. Now rinse in two warm and one cold waters, extract, and if not intending to dye directly, hang up to dry. If, however, you are ready to dye at once, examine the goods well, and see if all the grease spots, etc., are completely removed. We proceed with the dark goods in exactly the same way, but giving a little more alkali; increasing the amount if it is desirable to strip them much; at the same time being careful not to injure the fabric by an overdose. As already stated, this stripping off of the color is not always advantageous, on the contrary, there are many instances in which it is a positive advantage and profit to retain all we can of the dye on the goods. This is more particularly the case with goods that are to be redyed the same color; also, though in a less degree, does it apply to articles where the existing color will form a bottom or constituent part of the one we wish to apply. To illustrate this: we have some scarlet or crimson damask window curtain to redye—perhaps very dirty and trifle faded—we thoroughly clean them as just stated, but omit all free alkali, using our soaps just milk-warm; rinse well; pass through a sharp sour, and dye. We find that the quantity of cochineal, etc., required for this purpose, is regulated by the body of color we are able to retain in the goods while scouring; and therefore, considering the price of such dye-drugs, this matter is surely worth some attention.

Again, where we have goods of a simple color to dye a compound color, it will be found in some cases merely necessary to give the other or absent constituent or constituents of the color sought for, entirely leaving out that represented by the color already on the cloth. For instance: suppose we have some blue cloth or yarn that we want either green or purple; if we can preserve a good body of

blue in these goods, we can get our green by simply giving the proper amount of yellow, or the purple by merely giving red.

It is a common practice with dyers to dispense altogether with scouring when the goods are for black; but we must confess we fail to see any advantage arising from this departure from the general treatment. It is urged in support of such conduct, that black, being the embodiment of all colors, does, by reason of its density, cover up or conceal all stains and dirt, and that a great saving is effected both in soap and time. Now let us see if this is borne out in practice. We dye a dress, coat, or other articles having more or less dirt and grease in it, and we find in most cases, upon looking the article over, that these imperfections are really hidden. But look at the same article, after it has been worn a short time, and we find that a little rubbing and exposure has sufficed to remove the kindly but unsubstantial veil that hid them from the workman's gaze. This alone should be enough to show him the impolicy of such a course, for the turning out of such work is not likely to add to his reputation as a good dyer, and therefore not calculated to increase his profits. There is an old maxim that says; "Whatever is worth doing at all is worth doing well;" and the dyer would be consulting his own interest did he follow its teaching. Before passing on to dyeing operations, it will not be out of place to make a few remarks on "bleaching." Woolens, silk and straw are bleached by exposing to the action of sulphurous acid, a gas produced by burning sulphur in an open vessel. The goods must be thoroughly wetted, and are then hung up straight and open in a close room or closet, and a pan of sulphur placed on the floor. When all is ready, we ignite the sulphur by dropping a piece of red hot iron in the pan and at once close the door. After remaining some hours, we take down and rinse in clear cold water, and as the white thus obtained has more or less of a yellowish tint, we proceed in the case of the woolen and silk goods to dye them white. For this purpose we take a clean vessel of cold water, giving the goods plenty of room, and if not very yellow, merely give a little blue; working in this until a good white. If, however, the goods seem very yellow, the blue will not do alone, but must be associated with a little red. Of course the quantities of coloring matter must be very minute, and should always be strained. We can use sulphate of indigo and cudbear for this white, or we can resort entirely to aniline colors.

We are not confined in these operations exclusively to white goods. Checks and mixes, such as scarlet and white, orange and

white, yellow and white, Prussian blue and white, or in fact any goods where the colored part has been dyed in a bath containing tin spirits, sulphuric acid, etc., will be much improved by this process, but for such as are mixed with sweet colors, as common black, brown, drab, olive, etc., we must content ourselves by passing through acidulated water as before described.

Cotton is bleached by being wrought in a solution of chloride of lime and soda, or by first working in chloride of lime only, and then passing through a sharp sour of vitriol. We must be particular to avoid having any loose bits of lime in the bleaching liquor, as wherever such come in contact with the goods a hole is the result. The best plan is to dissolve the lime in a separate vessel, and then pour through a strainer into the bleaching tub. Care must be taken not to let the solution exceed a certain strength, or the goods will be injured. It should in no instance stand above 1° of Twaddell's hydrometer, and for most purposes can be used weaker. It is of great importance that the goods be thoroughly washed or rinsed from the bleach, more especially if they are for dyeing.

In concluding this section of our work, we would explain, for the benefit of those unacquainted with their use, that the puncher and the punch-tub so often spoken of in the foregoing pages are indispensable aids in the "job dye-house." The puncher is made from a sound piece of birch or ash, three feet long and six inches square. From one end of this piece we saw out two slabs at right angles, two inches thick and eighteen inches long, thus leaving four legs each two inches square. Next reduce the other end, above these legs, to a uniform thickness of three inches, finally putting in a cross-piece or handle, fifteen inches long and one and one-half inches diameter, two inches from the top. The peculiarity of the punch-tub consists in the thickness of the bottom, which is four inches, and also from the fact of the latter being brought down flush with the bottom of the staves. This is for the purpose of giving increased strength and stability, and rendering it the better able to withstand the blows of the puncher. It is about two feet six inches in height, and the same in diameter at the top, gradually lessening toward the bottom, which is two feet across."

To Destroy Burrs with Chemicals.—Steep the wool in which the burrs exist several hours in a bath of sulphuric acid, 4° to 6° B., next pass it through a weak soda bath about 4° B. Dry the wool, using a pretty hot current of air. By this process the burrs are converted into dust.

To Remove Burrs from Wool by Chemical Means.—Prepare a bath of dilute muriatic acid, containing from 3 to 5 per cent. of the acid. A little sulphuric acid is sometimes added. After steeping in the bath for several hours, or over night, the wool is taken out and dried. The vegetable fiber is thus destroyed, being rendered friable, pulverulent, and easily removed on the cards. The process of separating cotton from wool is substantially the same.

Extracting Cotton from Delaines.—Take for delaines about one part of oil of vitriol to fourteen parts of water; put the dry rags into the solution, taking not less than 30 and not more than 45 minutes for this operation; leave in about five minutes. Get rid of the dust of the vegetable fiber by rubbing, etc., and wash in clear water or salt water (one pound of salt to one of wool.) If the fiber has been rendered harsh by the acid, use a little oil or cow's milk to soften it.

Cleaning Tag Locks and Clotted Wool.—Wool that is clotted with dirt needs subjecting to a sweating or softening process; the same is good for "tag-locks;" and this softening process is also good for wool that is badly fleece-grown. "Tag-locks" should be wetted down with hot scouring liquor in some place where the pile can be kept warm, and when the balls of dirt have become quite soft dry the whole and dust well; then scour. The dirtiest "tag-locks" can be cleaned in this way.

Wool Scouring Liquors.—A great array of formulas might be given here, each having done good service somewhere, each having been found wanting elsewhere. Never expose wool to more than 120° F., or less than 90° F. in a scouring liquor. To produce a good scouring liquor consider first the water used, overcome the impurities with the mildest chemicals which will answer the purpose and yet unite freely with the chemicals necessary to saponify the soluble natural grease. Soap and sal soda are mild and softening, but they felt the wool more quickly than soda ash, ammonia and some other alkalies. Soda ash, caustic soda, turpentine or rosin must be used in very small quantities, if used at all; they destroy the most valuable characteristics of fine wool.

To Remove Grease Spots.—Keep in a well-corked 4-ounce vial the best of benzine, to which has been added a few drops of ammonia. Shake well, dampen the spot and dry out with cloths and hot irons. Blotting paper is better than cloths in some instances.

Sizing.—For woolen yarn. To a solution of Irish moss which is thick enough to be "stringy," add light solution of glue. Boil well

together and cool. Some size with glue. Glue is safe, but if hard and brittle a very little wax will soften it. A very good size for woolen yarn or warps is made with gelatine 1 pound, glycerocolle 1 to 4 ounces, and 6 to 8 quarts of water, according to the strength of size desired.

Sizing for Cotton Yarn.—Water, 100 quarts; flour, 200 pounds: soap, 6 pounds; tallow, 8 pounds; molasses, 2 pounds. The flour is first digested during three months in the water, and then the whole is boiled together till perfectly limpid.

A good Size can be made with 40 pounds of starch and 1 pound of sulphate of zinc, to 200 quarts of water.

Boil 2 ounces of gum arabic in 6 ounces of water till all is dissolved, then add 4 ounces of wax and stir well till the wax is melted and fully incorporated; it is then ready to mix with a hot dressing made with 10 pounds of flour.

Ten pounds pale British gum; 2 pounds sulphate of aluminum; 24 pounds glycerine of 28° B., and 60 pounds of water.

Glues—*For Parchment.*—Parchment shavings, 1 pound; Water, 6 quarts. Boil until dissolved, then strain and evaporate slowly to the proper consistence.

Rice Glue or Japanese Cement.—Rice flour; Water, sufficient quantity. Mix together cold, then boil, stirring it all the time.

Liquid.—1. Glue, Water and Vinegar, each 2 parts. Dissolve in a water-bath, then add Alcohol, 1 part.

2. Cologne or strong glue, 2.2 pounds; Water, 1 quart. Dissolved over a gentle heat; add 7 ounces nitric acid 36°, in small quantities. Remove from the fire and cool.

3. White Glue, 16 ounces; White lead, dry, 4 ounces; Rain water, 2 pints. Add Alcohol, 4 ounces, and continue the heat for a few minutes.

Marine.—Dissolve India-rubber, 4 parts, in 34 parts of Coal-tar Naphtha; add powdered Shellac, 64 parts. While the mixture is hot it is poured upon metal plates in sheets. When required for use it is heated and then applied with a brush. Or, 1 part India-rubber, 12 parts of coal tar; heat gently, mix and add 20 parts of powdered Shellac. Pour out to cool. When used, heat to about 250°. Or, Glue, 12 parts; water, sufficient to dissolve; add yellow resin, 3 parts; and, when melted, add turpentine, 4 parts. Mix thoroughly together.

Strong Glue.—Add powdered chalk to common glue.

Gum Mucilage.—Oil of cloves poured into a bottle containing gum mucilage prevents it from becoming sour, (10 drops per quart).

Glue to Resist Moisture.—Five parts glue, 4 parts resin, 2 parts red ochre, mixed with the least practicable quantity of water. Or, 4 parts of glue, 1 part of boiled oil by weight, 1 part oxide of iron. Or, 1 pound of glue melted in 2 quarts of skimmed milk.

VARNISH FOR IRON AND STEEL.—Clear grains of mastic, 12 parts; camphor, 5 parts; sandarach, 15 parts; and elemi, 5 parts. Dissolve in a sufficient quantity of alcohol, and apply without heat. This varnish will retain its transparency, and the metallic brilliancy of the articles will not be obscured.

TO PREVENT IRON FROM RUSTING.—Warm it; then rub with white wax; put it again to the fire until the wax has pervaded the entire surface. Or, immerse tools or bright work in boiled linseed-oil and allow it to dry upon them.

VARNISH FOR DRAUGHTMEN'S PAPER.—Powdered Tragacanth, 1 part; water, 10 parts. Dissolve, and strain through clean gauze, then lay it smoothly upon the paper, previously stretched upon a board. This paper will take either oil or water-colors.

ANTI-FRICTION GREASE.—100 pounds tallow, 70 pounds palm-oil. Boiled together, and when cooled to 80°, strain through a sieve, and mix with 28 pounds of soda and 1½ gallons of water. For winter, take 25 pounds more oil in place of the tallow. Or, black lead, 1 part; lard, 4 parts.

BOOTH'S GREASE FOR RAILWAY AXLES.—Water, 1 gall.; clean tallow, 3 lbs.; palm-oil, 6 lbs.; common soda, ½ lb.; or, tallow, 8 lbs.; palm-oil, 10 lbs. To be heated to about 212°, and to be well stirred until it cools to 70°.

RIBBONS.—Italian organzine silk, either thrown in Italy or England from Italian raw silk (and principally the last) is used for the warp of the best English ribbons; Bengal and China organzine for inferior qualities. China, Bengal and Broussa singles, and English, thrown, are used largely for filling.

Bengal silk cannot be used for fine colors; Marabout is used for gauzes. The fineness of the silk is determined by the number of warp ends, measuring 72 yards in the ounce; fine silk, for instance, runs about 160 threads of that length to the ounce. One ounce in twenty is allowed for waste in the manufacture of silk into ribbons.

Ribbons are made according to a fixed standard of widths designated by different numbers of pence, which once, no doubt, denoted the price of the article, but at present have reference only to its breadth. The French distinguish their widths by simple numbers. Thus the English ribbons, from a quarter of an inch to about four and a half inches wide, are called from penny widths to forty penny widths; while the French have from No. 1 to No. 60. All dressed ribbons, as satins, gauzes, etc., are made in the loom one-twelfth of an inch wider than sarsanets; in order to allow for the diminution of breadth which results from the lengthwise stretching they receive in the operation of dressing; fine gauzes require an allowance of two-twelfths.

French satins are woven with the face downward, and are lighter in make than English, but have a peculiar richness and lustre owing to their superior silk. French ribbons in general have less weight of silk than the English. The transparency of gauze ribbon is produced by the kind of silk of which it is made, the fine hard twisted marabout which leaves the interstices clear. One warp thread only passes between each dent of the reed, and these are closer together than lute-strings and satins. In fine satins, there are eighty or more dents, and from ninety to one hundred and twenty picks to the inch. The plain gauze ribbons made at Coventry, called China gauzes, are chiefly those used for mourning—white, black and lavender, with satin on ground stripes. In the fancy gauze ribbons, the figures are frequently produced in a different color from the ground by the mixture of colors in the warp, the colors being warped separately. In the intervals of the figures, the colored threads are carried along the under side of the ribbon. It is said to have a double or treble figure, according to the number of colors passing through each dent. In some ribbons—gauzes in particular—these threads are cut away by the scissors after the ribbon is made. In brocades, the figure is made by small additional shuttles, thrown in partially across the ribbon, as the pattern may require, the connecting threads of the filling being clipped off. By damask is meant the laying of the warp over the filling to form the figure, in the manner of satin. The patterns are sometimes geometrical, but more frequently combinations of leaves, sprigs or flowers. In the superior French ribbons, groups and wreaths of flowers are executed with the richness and variety of hand embroidery. Novelties are continually being introduced in coloring and texture. In the ribbon manufacture the labor is nearly the same for the richer as for

the inferior goods, the difference consisting principally in the silk of which they are made. Cheap ribbons are generally made by reducing the warp silks, which is the most expensive, and making up the bulk of the ribbon with a larger proportion of the cheap material in the filling.

RULES AND EXAMPLES FOR CALCULATIONS.

Relative to Shrinkages.—To find the percentage, the actual shrinkage being known: Add two decimal ciphers to the pounds lost, and divide by the gross pounds.

To find the net cost, the per cent. of shrinkage and gross price being known: Divide the gross price by $1.00 less the percentage of shrinkage.

To Regulate Weight of Goods in Drying.—To correct the weight of goods in drying it is necessary to let them run up to gain weight; to stretch, if wanted lighter. It is not best to leave such important work to inferior workmen. It is an easy matter for the finisher to ascertain the loss of weight by cleansing. If, then, the raw piece is weighed, and the weight marked on the goods, he has but to deduct the loss of weight by percentage to ascertain the weight of the piece finished. Reduce the clean weight to ounces and divide the ounces total by the ounces wanted per yard, the quotient is the length to which the piece must be finished to be of the right weight. If the overseer will make this calculation and give the drying operatives the correct order, there should be no trouble with weights.

Rules for Yarn Calculations, &c.—To find the size number, the yards per pound or ounce being known.

The yards per pound divide by 1600 for woolen runs.
" " " " 560 for worsted numbers.
" " " " 840 for cotton numbers.
" " " " 20 and with the quotient divide 7000 for woolen grain numbers.

The yards per ounce divide by 100 for woolen runs.
" " " " 35 for worsted numbers.
" " " " 52½ for cotton numbers.
" " " " 20 and with the quotient divide 437.5 for woolen grain numbers.

Example.—What are the size numbers of a yarn, 6720 yards of which weigh a pound, or 420 yards of which weigh an ounce?

$420 \div 100$ or $6720 \div 1600 = 4\frac{2}{10}$ runs.

$420 \div 35$ or $6720 \div 560 = 12$ worsted number.

$420 \div 525$ or $6720 \div 840 = 8$ cotton number.

$6720 \div 20 = 336$ —— $7000 \div 336 = 20\frac{280}{336}$ woolen numbers in grains.

NOTE.—Ashton gives a very convenient grain table for these calculations.

To convert woolen yarn numbered by cuts, threads, and spindles per pound to other woolen yarn numbers:

Divide the number of cuts per pound by 3 and multiply by 20 to obtain the runs.

Multiply the threads per pound by 1.2, and multiply the spindles per pound by 7.2.

	Cotton Hank.		Worsted Hanks.		Runs.
240 yards=1 cut	$\frac{2}{7}$	or	$\frac{3}{7}$	or	$\frac{3}{20}$
8 cuts=1 head	$2\frac{2}{7}$	or	$3\frac{3}{7}$	or	$1\frac{1}{5}$
6 heads=1 spindle	$13\frac{5}{7}$	or	$20\frac{4}{7}$	or	$7\frac{1}{5}$

To ascertain the yards per pound by the grain number system, divide 7000 by the number of grains which 20 yards weigh, and multiply by 20.

Analysis: If 20 yards weigh 35 grains, in 7000 grains there will be as many times 20 yards as 35 is contained in 7000.

To convert grain numbers to run numbers, find the yards per pound and divide that number by 1600.

To convert grain numbers to worsted numbers, find the number of yards per pound and divide that number by 560.

To convert grain numbers to cotton numbers, find the number of yards as above and divide by 840.

To convert other numbers to grain numbers, divide 140000 by the yards per pound of the size to be reduced.

To convert run numbers into grain numbers, divide the yards per pound by 20 and use the quotient as a divisor with which to divide 7000.

To convert run numbers into worsted numbers, multiply the run number by 20 and divide by 7, or divide the number of yards per pound by 560.

To convert run numbers into cotton numbers, multiply the run number by 40 and divide by 21, or divide the number of yards per pound by 840.

To convert other numbers to run numbers, find the yards per pound and divide by 1600.

To convert other numbers to worsted numbers, find the yards per pound and divide by 560.

For cotton numbers, divide by 840.

Cotton Yarn Calculations.—To find the weight of the warp, the ends, yards and number of yarn being known; multiply the ends by the number of yards; divide the product by the size number, and the quotient obtained by 840.

Example.—A warp 450 yards long, 1700 ends, No. 25 yarn, what is the weight total?

$$1700 \times 450 = 765000 \div 25 = 30600 \div 840 = 36 \text{ lbs. } 7 \text{ oz.}$$

To find the total number of hanks in a warp, also the size number or hanks per pound, the ends, yards and weight being known: Multiply the ends by the yards and divide the product by 840 to find the total number of hanks. Divide the total number of hanks by the weight to find the size number.

Example.—A warp 450 yards, 1700 ends, weight 36 lbs 7 oz., how many hanks per warp; how many per pound:

$$1700 \times 450 = 765000 \div 840 = 910\tfrac{60}{84} \div 36\tfrac{7}{16} = \text{No. } 24.99.$$

Answer: $910\frac{60}{84}$ hanks per warp, and 24.99 hanks per lb.

To find the weight per yard of cloth, the weight of 1 square inch (in grains) being known: Multiply the weight of one inch by the square inches per yard (1944 for $\frac{6}{4}$ goods, 972 for $\frac{3}{4}$ goods), and divide the product by 437.5. The result is the desired weight in ounces.

To find the weight per yard from any sample the exact area of which is known: Ascertain the weight of the sample in grains which multiply by the area per yard in inches. Divide the product by the area of the sample and the quotient thus obtained by 437.5. The result will be the weight per yard in ounces.

Note.—Above rules will permit no error in estimating area or weight, the utmost exactness is necessary. For the purpose of making the sample just right in size, use a die.

To test the size of yarn or roving: For the cotton hank number (840 yards per hank.) Divide 250 by the weight of 30 yards in grains.

Example.—What is the size of yarn 30 yards of which weigh 25 grains?

$$250 \div 25 = \text{No. } 10.$$

Some cotton spinners weigh the roving by a system of 560 yards per hank, and only the yarn by the above rule; in this case reel and weigh 20 yards instead of thirty. In reeling roving great care must be taken not to stretch it, or let it hang loose. A good way to

measure is with a board say 3 ft. 4 in. long, 8 or 10 inches wide, lay the desired number of rovings upon this board full length; upon this lay another board exactly 3 feet long, cut off the projecting ends of the roving at each end, which leaves the exact measure under the board with the natural tension. No reeling will always give the same tension so nearly as this method when carefully done.

For the worsted hank Nos. 560 yards per hank, divide 250 by the weight of 20 yards in grains.

EXAMPLE.—What is the size number of yarn, 20 yards of which weigh 25 grains?

$$250 \div 25 = \text{No. } 10.$$

Another method is to use a weight of $12\frac{1}{2}$ grains, then the number of yards required to balance this weight represents the number of the size.

EXAMPLE.—No. 10 yarn would require 10 yards to balance $12\frac{1}{2}$ grains. Above example proves this because we then found that 20 yards weighed 25 grains.

To test woolen yarn (1600 yards per run): Divide 210 by the weight of 48 yards in grains.

EXAMPLE.—What is the size number in runs of a yarn 48 yards of which weigh 30 grains.

$$210 \div 30 = 7 \text{ run.}$$

To ascertain the size of roving needed for the size of yarn wanted: Multiply the yarn size by 5 and divide by 3 for grain numbers, for runs, worsted and cotton numbers reverse; multiply by 3 and divide by 5.

NOTE.—This is only a general rule. It is impossible to give a short rule from which it will not be necessary to deviate often. The above is for a single roving. When two rovings are spun into one thread some spinners reverse the rule. Many woolen spinners want nearly all their rovings about double the size of the yarn to be.

The importance of universal uniformity in the methods for attaining and designating yarn numbers is thoroughly realized by those who have met with difficulties arising from a different course; it would seem that any one might comprehend the benefits thereof. The following from a lecture by Thomas R. Ashenhurst may help to convince some:

"Worsted yarns are calculated by the hank of 560 yards, made up in the following manner. By the old system of reeling, all worsted was reeled or made into hanks upon a reel of one yard cir-

cumference; at the end of the reel was attached an indicator, which was so arranged that at every 80 revolutions of the reel it gave a rap or snap, consequently 80 yards was termed one rap. At each rap the reel was moved slightly to one side, so that the next rap was wound separately, and so on until seven raps had been made, then the seven raps were made up into one hank, consequently seven raps of 80 yards each gives 560 yards for one hank. To indicate the counts of the yarn, as many hanks of 560 yards each as weigh one pound avoirdupois, is termed the counts, thus if 30 hanks weigh 1 pound the yarn is termed 30's, if 40 hanks weigh 1 pound the yarn is 40's, and so on. This in itself is not a very difficult system of calculation to deal with, but to make it a little more intricate, worsted yarn is usually sold by the gross (in England). The gross consists of 12 dozen or 144 hanks, so that on purchasing yarn of a given count by the gross it requires a little calculation to find what price per pound you are paying for the yarn.

In cotton yarns, a similar system of indicating the counts of the yarn prevails, but instead of the hank of cotton being 560 yards as in worsted, it consists of 840 yards. The length of the cotton hank is determined in the same manner as the worsted hanks, the difference in the length of the hank being brought about by the difference in the circumference of the reel, being 54 inches or $1\frac{1}{2}$ yards in circumference, instead of 1 yard as in worsted. The same number of revolutions make one rap, and the same number of raps one hank. Hence the cotton hank is one half longer than the worsted or 840 yards instead of 560. The number of hanks per pound indicates the counts, so that if we take the same counts of yarn in cotton and worsted, one will represent half as many more yards per pound as the other.

Spun silks are calculated on the same basis as cotton, the same number of yards per hank, and the hanks per pound indicating the counts. There is one important difference between silk and the other two materials I have named, which requires to be borne very carefully in mind in making a calculation. This difference refers to twofold yarns. When speaking of twofold cotton or worsted, the actual counts of the yarn is only half of what it is termed, thus in speaking of twofold 60's cotton or worsted the actual counts of the yarn is 30's, simply because it is two threads of 60's put together, making one thread of double the weight. So that if the yarn in its original or single state required 60 hanks to weigh 1 pound, when two threads are put together only 30 hanks would be required to weigh 1 pound. But in dealing with spun silk whatever the counts

of the yarn is called whether single or twofold, it requires the full number of hanks per pound. Thus, if we speak of 60's silk, whether single or twofold, we should have 60 hanks per pound. At first sight it would seem rather difficult to indicate in a ready manner this difference, but the method of writing the counts sufficiently represents this, at least to those who are acquainted with it. In writing twofold 60's in worsted or cotton it is usually put 2|60's, thus indicating that the yarn is two threads of 60's, but in silk it is written 60|2, showing clearly that yarn is still 60's though a twofold yarn. Of course, to anyone uninitiated, this difference might not be sufficiently clear, and one can easily understand numerous mistakes being made by anyone not perfectly familiar with the system. Though it may be difficult to understand why such a difference of system should exist, there is no doubt it does exist, and exists as one of the abuses with which I wish to deal.

While spun silks are calculated on the same basis as cotton—with the exception I have pointed out in twofold yarns,—raw silks are calculated on a totally different basis. The system most generally in use for raw silk is the hank of 1,000 yards, and the number of hanks per ounce indicating the counts, or in some cases the number of deniers which the hank weighs indicates the number of counts. But here again we find some difficulty in determining what is meant by the denier. The value of this weight has been variously estimated. If we refer to the "Cabinet Cyclopœdia" published by Messrs. Longman, in 1831, we shall find in the treatise on the silk manufacture that in reeling silk "A reel so constructed as that the circumference of a skein wound upon it shall be of a certain known admeasurement, is made to perform a given number of revolutions, usually 400, when the skein is accurately weighed. The comparative weights of silk whereby their fineness is denoted, are estimated in weights called deniers, 20 of which are equal to 16½ grains." Here we have some sort of data for the value of the denier, but nothing reliable for the length of the skein. Mr. B. F. Cobb, the Secretary of the Silk Supply Association, does not enlighten us much upon this matter. In his "Treatise on Silk" in the "British Manufacturing Industries" series, published by Stanford, 1876, he says, "Its fineness is not entirely judged by the eye, but by weighing a given length, generally 400 revolutions of a reel made for the purpose, the weight being expressed by a technical weight termed "denier," 200 of which are equal to 16½ grains." I think it is more than probable the 200 here given is a misprint and should have been 20. In that case the weight of the denier would be precisely the same as the

one I before quoted. But Mr. Cobb does not give us the circumference of the reel, so that we are no nearer. Before we go any further in the matter of the length, we might examine a little further into the value of the denier. The weight of the denier as given by the "Cabinet Cyclopedia," and by Mr. Cobb (assuming that the 200 is a misprint for 20), would be equal to 0.825 of an English grain. The celebrated Dr. Ure in his "Philosophy of Manufacture," says, he understood the denier to be equal to 0.693 of an English grain, but upon testing a denier weight he found it to be equal to 0.833 of a grain. Mr. Simmonds, in his Appendix to the "Philosophy of Manufactures" says, "The custom of the trade is to reckon 32 deniers to a dram, and that the standard of silk measure is about 400 yards, that length of a single filament of China Cocoons will weigh two deniers, and of French or Italian about $2\frac{1}{2}$." Reckoning the denier on the basis of 32 to equal one dram avoirdupois, the weight of the denier would be 0.854 of a grain, or a little heavier than the weight found by Dr. Ure, and that given by the "Cabinet Cyclopedia" and Mr. Cobb.

In Macclesfield 530 deniers are equal to an ounce, and 530 yards the standard length to weigh. If we take the Macclesfield standard, that will give us the weight of the denier as equal to 0,8245 of a grain. I think it is more than probable that this will be the correct weight of the denier, the standard of length reeled and the standard of weight being both based upon 530, and we find that the other weights are so nearly approximate to it. Then if we take the 530 yards and 400 revolutions of the reel we shall find the circumference of the reel to be as nearly as possible four feet ($47\frac{7}{10}$ inches). This seems to be the most reliable data to which we can turn, and although our conclusions are unsatisfactory, we have no means of arriving at anything better, and difficult as this matter is to deal with, I shall show you that difficulties are not confined to the silk trade alone. This difficulty in silk calculation is now somewhat obviated by the adoption in many places, of the system of counting by the number of 1000 yards per ounce.

The Linen Trade is the only one which is regulated by law in England, and that regulation only refers to the length of the hank, or cut; the circumference of the linen reel is 90 inches, and 120 revolutions makes one lea, (or what is termed in worsted and cotton "rap,") consequently 300 yards make one lea, generally the number of leas per pound indicates the counts, but I shall show you presently that although 300 yards is always taken as the basis there are local customs in this material as well.

We now come to deal with the material in which perhaps the greatest diversity exists, vis.: Woolen. If we take all the woolen manufacturing districts of England and Scotland, we shall scarcely find any two which have the same system of calculation, and the difference of systems exists not only between district and district, but in some cases between town and town, or village and village.

It would be impossible for me, even if I was intimately acquainted with all the various systems to enter into them in detail, in the time at my disposal. I shall therefore select a few for the purpose of comparison. I will begin with those near home, as they will probably have most interest for you, and will be most likely to be useful.

Generally speaking (in England at least), woolen yarns are calculated by the skein, but the skein, like some of the other units of calculation I have shown you, is a variable quantity, representing a different quantity in different districts, and in many cases only very imperfectly understood. If you go into the town of Huddersfield, and ask a number of people what is a skein, you will probably receive a variety of answers. At least you will receive two. One will say, "A skein is one yard." Another will say, "A skein is 1536 yards" And if you ask them how they ascertain the counts of the yarn the answer will be "by the number of yards in one drachm." In one sense perhaps we might say that both the answers to the first question are correct. As a matter of calculation they would both give the same result. What is commonly known as the Yorkshire skein system, and as practised at Huddersfield and Leeds, is based upon the old system of preparing the wool for spinning, by what is known as the "Slubbing Billy." By this system the wool had to be weighed in small quantities, and each weighing was termed a "Wartern ;" this wartern was not one universal weight, but in the system we have under consideration was 6 pounds, thus as each pound avoirdupois contains 256 drachms, 6 pounds contains 1536 drachms. Therefore, the number of yards in one skein equals the number of drachms in one "wartern." Thus if one "wartern" makes only one skein of yarn the counts of that yarn would be 1's, but if one wartern makes 20 skeins then the counts of the yarn would be 20's. Consequently there being the same number of yards in one skein as there are drachms in one "wartern," as many yards of yarn as weigh one drachm, so must the same number of skeins of necessity weigh one "wartern." This being the case no matter what we may take as the weight of the wartern, if we keep the same number of yards per skein, as we have drachms per wartern, the yards per drachm must always indicate the counts of the yarn.

The weight of a wartern does vary, but upon this principle the counts of the yarn will be the same.

Sometimes woolen yarn is reckoned by the hank of 840 yards in the same manner as cotton, but generally when this is done the number of hanks per pound does not indicate the counts, but one-third is added, thus if there are 20 hanks per pound it would be termed 30's, or making it exactly equal to worsted. If we take the west of England system of woolen calculation we find it different from these. There the calculation is based upon 20 yards per ounce, or 320 yards per pound, so that as many times 20 yards as weigh one ounce, that is termed the counts of the yarn. Thus, if there are 400 yards (20 times 20 yards) per ounce, it would be termed 20 skein yarn. Another system which prevails, and which if I remember right is known as the "Cumberland bunch Count," determines the count of the yarn by the ounces weight of a bunch of 3,360 yards. This bunch is equal to four cotton hanks, or, six worsted hanks, and originated in the old system of tying up the yarn in bunches of so many hanks each. Again, nearer home we have the Dewsbury system, based upon the number of yards per ounce.

If we go to Scotland we find as great, if not greater, diversity existing. At Galashiels the counts is based upon the cut of 300 yards each in a pound of 24 ounces, or 384 drachms. At Hawick it is based upon the pound of 26 ounces, or 416 drachms, the cut of 300 yards being the standard unit. At Alva and Stirling; Dundee and Aberdeen, the spindle is the basis of calculation, and the pounds weight of the spindle indicates the counts of yarn. In the spindle as in all the other units of calculation, we have a variable quantity. The Aberdeen spindle, as used for the woolen and linen trades consists of 14,400 yards, or equal to 48 cuts or linen leas of 300 yards each. The reel upon which the yarn is reeled is 90 inches, and the table of lengths runs as follows :

120 Threads (90 inches each)	=	1 Cut	=	300	yards.
2 Cuts	=	1 Heer	=	600	"
3 Heers	=	1 Slip	=	1,800	"
2 Slips	=	1 Hank	=	3,600	"
2 Hanks	=	1 Hesp	=	7,200	"
2 Hesps	=	1 Spindle	=	14,400	"

Or, to put the matter briefly, the counts of the yarn is the pounds which 48 leas of 300 yards each weigh, so that 1's or 1 pound yarn would be equal to 48 leas per pound, or 900 yards per ounce.

The Dundee spindle (except for linen yarns when it is the same as Aberdeen), consists of 15,120 yards, and the weight of the spindle indicates the counts of the yarn, and is expressed in similar terms to the Aberdeen counts, as so many pounds yarn. This spindle is made up of 18 hanks of 840 yards each, so that 1 pound of yarn would be equal to 18 hanks of 840 yards each per pound.

The Alva and Stirling spindle consists of 11,520 yards, and the counts indicated by the number of spindles in 24 pounds, or 480 yards per pound.

I think I have now dwelt sufficiently on the different systems, I will endeavor to put the matter before you now in a different form, so that you can more easily make a comparison. Most of you are familiar with what is called 20's yarn. Of course 20's yarn may exist in all the different systems I have shown you. Then if we take 20's in all the different systems, and see how many yards per pound we should have in each case, we shall have a fair standard of comparison. The list is as follows:

Worsted................	20's	=	11,200	yards	per lb.
Cotton	"	=	16,800	"	"
Spun Silk	"	=	16,800	"	"
Raw "	"	=	320,000	"	"
Linen (ordinary)	"	=	6,000	"	"
Woolen (Yorkshire Skein)	"	=	5,120	"	"
" (West of England)	"	=	6,400	"	"
" (Dewsbury)......	"	=	320	"	"
" (Bunch Count)...	"	=	2,688	"	"
Aberdeen...............	"	=	720	"	"
Dundee	"	=	302,400	"	"
Alva and Stirling	"	=	9,600	"	"

From this it will be seen that by the 12 different systems of counting yarns which I have given you, for a yarn which is known by the same number, the weight varies from 320 yards per pound to 320,000 yards per pound. If that is not an absurdity in figures, I am afraid it would be difficult to find one in existence, either in the textile trade or in any other department of industry.

Before leaving this branch of the subject, I will make one more comparison. I will again take 20's worsted as my standard, as it will be most familiar to you. Taking the number of yards in one pound of 20's worsted, let us see what counts that number of yards per pound would represent in all those different systems. 20's

worsted is equal to 11,200 yards per pound, that number of yards per pound would give us in

Cotton	Counts	$13\frac{1}{3}$
Spun Silk	"	$13\frac{1}{3}$
Raw	"	700 or $\frac{7}{10}$
Linen (ordinary)	"	$37\frac{1}{3}$
Woolen (Yorkshire Skein).	"	$42\frac{3}{4}$
" (West of England)	"	$24\frac{7}{8}$
" (Dewsbury)	"	700
" (Bunch Count)	"	$3\frac{1}{5}$
Aberdeen	"	$1\frac{2}{7}$ lb. yarn.
Dundee	"	$1\frac{7}{21}$ "
Alva and Stirling	"	$17\frac{1}{7}$
Galashiels	"	$44\frac{4}{5}$
Hawick	"	$48\frac{8}{15}$

From these figures we see at once the relative value of the counts in the different systems of calculation, and also how much the unit of counts varies in different districts. It will also enable you to understand in some degree the difficulty of speaking of counts, unless the number of the yarn is accompanied by an explanation of the system by which the counts are indicated. If I was to speaks of 20 skein woolen in Bradford, only a comparative few would understand what was meant. Or 20 skein woolen Yorkshire count would be unintelligible to a great many west of England manufacturers.

There is one other branch of the subject to which I must call your attention, viz., the reeling or testing of yarns. Of course it must be obvious that in ascertaining the counts of yarn you cannot always have at hand as much yarn as will represent the standard unit of weight by which the yarn is indicated. If so you would always require 1 pound of cotton, worsted or silk, and 6 pounds of woolen; whereas, in many cases only a very small quantity is available. Then some small weight must be found which will readily indicate the counts of the yarn. In woolen (Yorkshire skein) this is quite easy, because the number of yards in one drachm indicates the number of skeins in one wartern, so that only one drachm need to be weighed. But in worsted and cotton this is not quite so easy. The readiest method is to reduce the pound avoirdupois to Troy grains and divide that by the yard in one hank, thus 7,000 Troy grains are equal to 1 pound avoirdupois; the 7,000 divided by 560 the yards in one hank would give us $12\frac{1}{2}$ grains, consequently, as many yards as weigh $12\frac{1}{2}$ grains, so many hanks of 560 yards each

will weigh one pound avoirdupois. If we require a weight for cotton or spun silk, then divide 7,000 by 840, and we have $8\frac{1}{3}$ grains as a standard weight for testing cotton. This is perhaps as great an absurdity as exists in the whole system of yarn counting, indicating the counts of yarn by an unit of avoirdupois, and testing it by Troy weight. Yet it is the method most generally practised, and is certainly under existing circümstances, in most cases, the most convenient.

In dealing with twofold yarns a somewhat peculiar, or at least what appears to be a peculiar, system of calculation comes into use. If the two threads which are put together are each of the same thickness the calculation is quite simple, because it makes a thread of double the weight, and consequently would be termed half the counts; thus two-threads of 60's would make a 30's thread, or equal to 30 hanks per pound. At first sight it would seem that if two threads of 60's make one of 30's that one of 80's and one of 40's together would also make one equal to 30's, but in point of fact that is not the case. If we take one hank of 80's worsted we shall find it weighs 3.2 drachms; and a hank of 40's worsted weighs 6.4 drachms. If we put those two together as one thread we have a hank weighing 9.6 drachms, and 9.6 drachms is the weight of a hank of yarn which would be equal to $26\frac{2}{3}$ hanks per pound. Consequently the counts of a two-fold thread consisting of 80's and 40's would not be 30's but $26\frac{2}{3}$'s. There are several so called short methods of ascertaining the counts of two-fold yarns of this description. One is to divide the highest by itself, and by each of the others and then by the quotients added, and the last quotient will be the counts of the doubled yarn, thus—

$$80 \div 80 = 1$$
$$80 \div 40 = 2$$

$80 \div 3 = 26\frac{2}{3}$ the counts of the two-fold yarn. This rule will answer when any number of threads of varying counts are put together; and in many cases will undoubtedly prove a very convenient one, because it is easy of application. Another method is to divide the product of the two counts by their sum, thus $\frac{80 \times 40}{80 + 40} = 26\frac{2}{3}$. This will answer the purpose quite as well as the previous one, but *only when two threads* are put together. It will perhaps be as well to examine this a little more fully. The whole question resolves itself into one of simple proportion. When we put two threads together the resulting thread

bears the same proportion to the lowest count which the highest does to the sum of the two; or, in other words, we have in the counts of each thread two mean proportionals; the sum of the two is one extreme, and the resulting count is the other extreme proportional, thus taking again the 80 and 40 the sum of the two is 120, then as $120 : 80 :: 40 : 26\frac{2}{3}$. This holds true of any material, or of any method of counting. As a proof of this we will suppose two threads of woolen twisted together, say a 20 and a 30 skein (Yorkshire count); the sum of those two would be 50, then $50 : 30 :: 20 : 12$, or 12's skein would be the counts of the resulting thread. Of course it may be put in the form I gave it before, that is divide the product of the two numbers by their sum, thus

$$\frac{30 \times 20}{30 + 20} = 12.$$

They both mean the same thing; it is merely a different way of stating the question. The same remark also applies to dividing the highest by itself and by the other, thus

$$30 \div 30 = 1$$
$$30 \div 20 = 1\tfrac{1}{2}$$
$$30 \div 2\tfrac{1}{2} = 12.$$

I should prefer putting the question as one of proportion direct, because it is easier to remember and bears its own truth on the face of it. But to prove that those two woolen threads I have given would produce one equal to 12 skein we will take the smallest convenient unit of length as a standard of test. I have already told you that the number of yards per drachm represents the count skein, then

20 yards	of 20's	would weigh	1 drachm.
20 "	30's	" $\frac{2}{3}$	"
20 "	of the double thread	$1\frac{2}{3}$	"

Consequently 20 yards weighing $1\frac{2}{3}$ drachms would be exactly equal to 12 yards to one drachm; therefore the counts of the doubled yarn must be 12's. If we have a greater number of threads than two together it becomes a question of continued proportion, but perhaps of a kind which will appear a little peculiar to many. For instance, when we are dealing with two threads the counts of the threads produced by doubling is a fourth proportional lower. If we put three threads together it would seem as if the resulting thread would be a fifth proportional lower, or that the sum of the

three would be one extreme, and the results of the counts the other extreme. But this is not so in the ordinary sense of double proportion, although it would be truly a double proportion. You could not multiply the three numbers together and divide by their sum. I will give you an example of this: Suppose we put three threads, one each of 80, 60 and 40 together, we should have a yarn equal to $18\frac{6}{13}$. If we seek this result by proportion we shall not obtain it so readily as by the first method I mentioned. To put the matter clearly, I will find the result of the first two threads, thus 80 and $60=140$. Then $140:80::60:34\frac{2}{7}$. The third thread 40 and $34\frac{2}{7}=74\frac{2}{7}$; then $74\frac{2}{7}:40::34\frac{2}{7}:18\frac{6}{13}$ the counts of the three threads together. Before we proceed further we will prove the truth of this. One hank of 80's worsted would weigh 3.2 drachms, one hank of 60's would weigh 4.26 drachms, and one hank of 40's would weigh 6.4; then $3.2+4.26+6.4=13.86$ drachms as the weight of one hank of the three-fold yarn.

One hank weighing 13.86 drachms would be $18\frac{6}{13}$ counts, or there would be that number of hanks in one pound. Then let us see how to obtain the result desired by the short method.

80	divided by	$80=1$
80	"	$60=1\frac{1}{3}$
80	"	$40=2$
80	"	$4\frac{1}{3}=18\frac{6}{13}$

If we have any number of threads to put together we may obtain the counts resulting by either of these methods, but generally speaking the last will be found the most convenient.

In all the calculations I have given I must ask you to bear in mind that I have made no allowance for waste or shrinkage. That is a matter which can only be determined by practice. If you are making a calculation for the quantity of material in a piece of fabric, to lay down a fixed proportion to allow for waste and shrinkage would only be misleading, because it would vary, not only according to the nature of the material but also according to the construction of the fabric. In the same manner on twisting two threads together there is a certain amount of shrinkage caused by the threads twisting around each other. Perhaps a fair average allowance might be fixed upon, but it could never be anything but an approximate calculation. The amount of shrinkage or, as it is generally termed, "take-up" in twisting two threads depends in no small measure upon the contiguity of the axis of the threads; for instance, if you take two threads of soft flexible material they will

embed themselves in each other, their axes will be nearly close together, and there will be very little loss of length by their twisting round each other; but if the threads are of a hard inflexible material there must be considerable "take-up," because the threads have to wind round each other, their axes cannot come near together, and the result is a proportionately heavier thread. If we put a thick and thin or fine thread together, unless the thick thread is of a very soft material, the fine thread will be wound upon the thick one in all probability—they will not twist round each other. In that case all the "take-up" would be in the fine thread, and the thick one would be perfectly straight, so that in making a calculation the circumstance of the case would require to be carefully considered, so as to ensure perfectly accurate results. The object I have had in view has been to show the readiest method of arriving at result, and to point out some of the absurdities of the different systems of calculation. It would be difficult to estimate the amount of time that is wasted in making calculations, and in these times of severe competition it is of the utmost importance that the time of both employer and employed should be utilized to the utmost. Not only is it important from a business point of view that calculations should be simplified to the utmost, but I apprehend that the man who can go through his work with the least labor, mentally as well as physically, is not only the most valuable man to his employer, but he is better in every way, because by simplifying his labor there must be less strain, and consequently less wear and tear of the human system; and he will be able to work longer, with more comfort, and end his labor with more pleasure than he could otherwise do.

We have in this department alone a wide field for improvement. It is scarcely conceivable that so many systems could exist; and small as the matter may seem to an ordinary observer, yet it is one of great importance. If a manufacturer in one district should find it necessary to purchase yarn from another district, he has to deal with a system of calculating that yarn which is quite foreign to that which he is accustomed to. If a workman finds it desirable or convenient to remove from one town to another, he has first to learn their system of calculation. Is there any reason for this diversity of system? Whatever may have been the reason or the object of all these systems when they originated, surely the same reasons cannot have much weight now; but many arguments might be adduced in favor of unformity. It would not be a difficult matter to find a great deal to complain of in our whole

system of weights and measures; but in one department of industry it seems almost inconceivable that all these systems, whatever may have been their origin, can be allowed to exist. There can be no doubt that uniformity would do a great deal in promoting business intercourse between different districts, because we should then know how to estimate the value of the article in which we were dealing. There is little doubt that this uniformity will be attained. Education will do a great deal towards it; and I have confident hopes that we shall see the day when we shall have one standard unit by which to reckon all our yarns; and that this standard will be arranged upon some intelligent basis, so that the mystery which has usually attended textile calculations will be put an end to, and we shall have it so simplified that every one whose duty it may be to make those calculations will be able to do it with ease and comfort.

SCALES.—Measuring and weighing scales are needed about factories in great variety. Of measuring scales, there are none more important than a finely graduated scale which may be used to measure patterns, count threads, turns of twist, &c., &c., with the naked eye. For many purposes a common pocket rule may answer, but for others a much more convenient gauge or scale is necessary to make sure of accurate work. Likewise the scales necessary to use in combination with magnifying glasses and microscopes, should be well adapted to the many kinds of work to be done with them. Linen provers, with or without lenses, may be considered in this class. Linen provers should be purchased in combination with some firm and convenient contrivance for permitting the reflection of strong light through the fabric to be examined. Many thin fabrics can be examined easily with such an improvement to linen provers, whereas without them they would be as difficult as any heavier piece.

Scales for weighing should be very delicately constructed to meet the designer's requirements. Of scales of all kinds used in factories, as of many other articles, it may safely be asserted that the best are always the cheapest. By the best we do not mean the dearest, although very good and fine scales are expensive, but such as may be depended upon for accuracy and durability, without extra or unnecessary ornamentation.

SCOTCH, ENGLISH AND AMERICAN TERMS.—

South of Scotland.	Yorkshire.	American.
Twice Drawn,	Roved,	Double Spun.
Porters,	Porties,	Porters.
Reed,	Slay,	Reed.
Split,	Reed,	Dent or Split.
Heddle,	Heald,	Heddles.
Leaves,	Shafts,	Harnesses.
Shots,	Picks,	Picks.
Caulm,	Gear,	--------
Heddle Eyes,	Neezes,	Heddle Eyes.
Celtic,	Hopsack,	Celtic.

TABLE OF MEASURES.—

1 Cut=300 yards=10,800 inches.

1 Slip=12 cuts=3600 yards.

1 Ell, relating to caulm and reed=37 inches.

1 Ell, relating to warp yarns in warping and weaving=45 inches.

1 Porter=40 threads. Hawick knot=80 threads.

1 Porter, 2 in split, of any reed=20 splits. Originally all webs were 2 threads in split.

1 Porter, 4 in split, of any reed=10 splits.

1 " 3 " " " $13\frac{1}{3}$ "

The number of a reed is the number of porters on 37 inches, thus a 20 reed is 20 times 20=400 splits on 37 inches; an 18 reed is 18 times 20=360 splits on 37 inches; and so on with all the other numbers of reeds.

Yarn Greasy Weight.	*Machine Wool Weight.*
1 oz.=16 drachms.	1 oz.=16 drachms.
1 lb.=24 oz.=384 drachms.	1 lb.=16 oz.=256 drachms.
1 lb. Hawick 26 oz.=416 drachms.	1 stone=24 lbs.=6144 drachms.

Skein, 1520 yards=1 porty, 12 strings long.

Werturn, 6 lbs.=1536 drachms.

String=120 inches.

Porty=38 threads.

Sett in slay is the number of porties of 19 reeds in 9 inches. The number of skeins is the number of yards in a drachm, thus 10 skein of yarn is 10 yards in a drachm, 12 skeins=12 yards in a drachm, and so on; and is related to Gala $\times$ by $1\frac{4}{15}$; but the Yorkshire skein is as $\times$ by $1\frac{7}{25}$, being a slight deviation for convenience in calculation by the werturn of 6 lbs.=1536

drachms, instead of 1520 yards, 1 skein. The yarn is, therefore, finer or longer by 16 yards in a werturn than it is given up for.

For rules to find equivalent quantities, in various English systems, see Johnston's "Hand-Book for Designers."

Sizing.—The most important considerations upon which successful sizing depends are:

1. The quality and kind of the ingredients.
2. The mode of preparing the size.
3. The method and extent of application.

The vegetable ingredients used, such as flour, potato starch, etc., are valued for sizing according to the amount of gluten they contain, notwithstanding starch plays the most important part. The following table shows the comparative richness in gluten and starch of five kinds of grain:

	Wheat.	Indian Corn.	Rice.	Rye.	Barley.
Gluten and Albumen	19.15	12.3	12.76	9.48	6.24
Starch	65.68	71.	86.9	61.07	69.5
Febrine, Gum, Sugar	14.09	0.4	0.5	3.28	....
Saline Matter or Ash	0.70	1.2	0.9	....	....

In damaged flour the gluten may be only deprived of its elasticity, or it may be entirely destroyed.

Indian corn contains more fatty matter than any other grain, and rice less.

Tallow must be used for some purposes, but it is liable to induce mildew.

Cocoa-nut oil is inferior to tallow on account of its liability to become rancid.

Palm oil is more extensively used than cocoa-nut oil, and is much better.

China-Clay.—"It would be difficult to find a substitute for this important ingredient of size, or one that possesses the same combination of useful properties. I need only state, for the benefit of the uninformed, that it is not, as they generally suppose, a quantity of rubbish introduced solely for the purpose of weighting, but its unctuous and soft nature is taken advantage of in providing what might be called a soapy coating to the warp well adapted for weaving; at the same time it can be made to fulfil the other requirements in a very efficient manner, filling the fibre and giving a "feel" to the cloth hard to obtain by other means. In this it acts a purely

mechanical part by rendering the paste of the flour less persistent, it prevents that too powerful shrinking of the size when dried on hot cylinders, which has the effect of contracting the yarn. Its specific gravity also better adapts it for use than many of the heavier mineral substances, such as barytes, &c., which have been recommended, as it is less liable to settle or cake, stopping up the holes in the boiling pipes. It is a matter of very considerable importance to select a good quality of China-clay, called by potters 'fat clay.'" —*E. Webb, in Warp Sizing.*

A good clay for sizing will yield about the following proportions in analysis:

Silica	46.32
Alumina	39.74
Protoxide of Iron	.27
Lime	.36
Magnesia	.44
Water and some Alkali	12.67
Loss	.20
	100.00

Chloride or Muriate of Zinc, or Zinc Size.—When properly prepared possesses properties of great value to the warp-sizer. Ignorance has brought it into disrepute, but for some classes of warp sizing it is indispensable. In preparing it, however, a practical knowledge of chemistry is necessary. (See E. Webb on Warp Sizing.)

Chloride of Magnesia.—The use of this salt is now more common than formerly when covered with several patents, but it has not, and probably cannot afford, all the benefits expected from and claimed for it. It is more liable to mildew than chloride of zinc. The mode of preparing the size should be governed largely by the ingredients used, and result desired. The application of sizing is a practical question varying materially in the many uses made of sizing.

TESTS.—A long list of tests should be in possession of every manager and designer. Without pretending to give such a list a few good ones will not be objectionable.

Soap Tests of Water.—Dissolve a piece of good soap in alcohol to thickness of a syrup; drop this into a sample of water; if it curdles the water is hard; which means that there are present: carbonic acid, carbonate of lime, iron sulphate of lime, etc., etc. If soft it may contain alkalies.

Acid Test of Indigo Colors.—Nitric acid will turn indigo to a light lemon yellow; logwood to red orange; Prussian blue to green. Do not use the acid too strong.

To Distinguish Dyes in Colored Goods.—It is often necessary to know with what coloring matters a pattern has been dyed. In some cases an experienced dyer can soon ascertain, almost at a glance, or by simple methods, which dyestuff has been employed; but with many colors this is sometimes impossible. Especially is this the case with blue dyed fabrics, in which it is not easy to say whether a pattern has been dyed with vat indigo alone, or has been topped with cheaper stuff. This detection can be made by a chemical analysis, the method consisting in destroying one of the coloring matters by some reagent, and thus prove its existence by the use of the destroying medium. To ascertain which mordant has been used, it is only necessary to burn a certain quantity of the fabric, and to find out by chemical analysis which oxide was present on the fabric. These methods are, however, only of use to chemists; but the following is a simple method that may be employed by anybody to determine the coloring matter. To begin with blue dyed fabrics. Vat blue, in the first place, is neither affected by alkalies nor acids (with the exception of nitric acid). Only chlorine and chlorine compounds react on vat blue. A blue dyed with sulphate or extract, or carmine of indigo, is readily abstracted by boiling water, and even more so by caustic alkalies. Prussian blue is easily recognized by using alkalies which destroy it, while chlorine and acids have no effect upon it. However, the alkaline chlorine compounds of commerce (bleaching powder, etc.) react upon it. Goods dyed with logwood give, with acids, a coloration more or less yellowish. In case there is another color associated with logwood, the latter may be extracted with a large quantity of acid. The fabric is then well washed, and the remaining color examined. The red colors are more difficult to determine; but these colors have not the same importance as the blues. Colors dyed with cochineal and Brazil wood (which, however, every dyer can easily distinguish) become gooseberry red when treated with muriatic acid. If it is washed, and then passed through milk of lime, a pretty loose violet is obtained. Madder red, treated exactly in the same way, and after the milk of lime bath boiled with soap, acquires a more intense color. Cochineal red and Brazil wood red can be easily distinguished by means of oxalic acid, cochineal red becoming brighter, while the other is more or less destroyed. Black, which is generally dyed by two methods, either with iron or

chrome, when treated with chlorine, is destroyed if dyed with iron; but, if a chrome black, resists to a certain extent, only becoming chestnut brown, even with strong treatment. To distinguish other colors there are many methods, which are, however, too complicated to be mentioned here. Aniline colors require greater chemical knowledge to distinguish them from each other.

Character of Animal Fibers.—"Fibers having an animal origin do not burn, like those of the vegetable kingdom, with a continuous flame, but ignite with a sort of fusion, and exhale a nauseating odor, similar to that of burning horn, while forming a carbonized ball on the extremity of the thread. Subjected to a dry distillation, animal fibers reject some tarry composition containing carbonate of ammonia, which can be recognized by its peculiar odor and by its alkaline property of bluing litmus-paper. It is a gelatinous albuminious compound, containing the following constituents:

Carbon	50-75
Hydrogen	7-03
Azote	17-71
Oxygen Sulphur	25-51=100-00

Wool, as it is used specially, contains a notable proportion of sulphur, which will manifest itself under proper conditions. Thus, subjected to 148° Centigrade, wool will evolve sulphur readily; also on boiling it in water.

It is the action of this sulphur which blackens the wool in high temperature, especially if brought in contact with some metallic substance, such as acetate of lead, protochloride of tin, or with any metallic surfaces. In a boiling solution of nitrate of lead, wool gets covered with sulphate of lead, and becomes instantly black. These facts are important to know for the management of the dyeing operations. Alkali can remove the sulphur in the wool. In the great carpet factory of the Gobelins all the wool yarn in hanks is subjected for twenty-four hours to a milk of lime bath, after which to a chlorhydric acid bath, followed finally by a water washing. Animal fibers are sensitive to the action of caustic alkali. These agents must not be concentrated for wool. Carbonate of soda will not injure wool, but caustic soda will. Sulphuric acid concentrated decomposes silk rapidly, also wool and hair; but diluted with water it produces some interesting effects. For instance, any wool cloth saturated in a sulphuric acid bath at 2°, will suffer a considerable contraction, but will never be attacked by insects. Nitric acid produces a yellow tinge on silk, and on wool generating a yellow

color called *canthoproteic*. There is a tendency to utilize this dyeing property in the trade, but it should be rejected as injuring the chemical constitution of the fiber. The weak acids act well enough on animal fibers for dyeing. For instance, a solution of fuchsin with an alkali can dye red, while vegetable fibers could not give such a result.—*Le Jacquard.*

TESTS BY WHICH THE MIXTURE OF COTTON, FLAX OR JUTE IN WOOLEN AND SILK GOODS MAY BE DETECTED.—Boil woolen or silk goods in ten per cent of caustic soda lye, and the wool or silk will be dissolved, leaving the cotton or any other vegetable fiber. The undissolved portion may be bleached in chlorine water, if it is colored, and then dissolved by cupro-ammonia.

Woolen and silk, if highly colored, may also be treated with a mixture of two parts of sulphuric and one part of nitric acid. The wool, silk, and coloring matters will be destroyed, while the cotton will be turned into gun cotton, which will explode by being struck with a hammer.

If the woolen or silk is white, an easy test is by a solution of fuchsin. This will dye the wool or silk, but not the cotton. All sizing must be removed before applying this test, which is best accomplished by washing in a weak solution of carbonate of soda and in soap, and applying the fuchsin mixed hot with some carbonate of soda.

To detect wool in silk, a solution of oxide of lead in caustic soda can be employed, which turns woolen goods black, owing to the sulphur of the wool combining with the lead.

Silk in wool is shown by its solubility in a cold solution of cupro-ammonia—from this solution acids precipitate the silk in flocks.

Wool is only soluble in cupro-ammonia by aid of heat. Concentrated acids, such as sulphuric, nitric, or preferably hydrochloric, act in the cold upon silk, but not on wool. The dissolving properties of cupro-ammonia on all vegetable fibers make it one of the most useful of tests. It is prepared by suspending strips of copper in concentrated ammonia in a large flask, tightly corked, and occasionally shaken, so as to bring the metal in contact with the oxygen of the air. A good plan is to transfer the contents from one flask to another. By degrees a tolerably concentrated solution of oxide of copper in ammonia is obtained which dissolves cotton, tow, jute, and other vegetable fibers, leaving animal fibers untouched.—*From a German work on " The Tests of Fibers," by Prof. Emil Kopp.*

Another means more easily accessible than resort to chemistry, for which few than professional analysts would be disposed, is the microscope. There is necessarily a vast difference between animal and vegetable fibers, and again between the different species of each of these classes. This difference, however they may be intertwined, will become at once apparent on the application of powerful magnifying lenses. Yet the mere natural appearance must not be wholly relied upon. Years since, for instance, the important discovery was made of the influence of caustic alkali in modifying the fiber of cotton. By steeping the fiber in a cold solution of caustic soda, it loses its flattened ribbon-like form and assumes a more or less cylindrical shape. This change gives rise to three remarkable effects ; the fiber becomes smaller, it gains in strength and at the same time it acquires increased affinity for coloring matter. Then it is important to become acquainted with the varieties of different species of fiber. Such an accomplishment, in connection with chemical and microscopic tests, would undoubtedly be of great value to the buyer, especially of many descriptions of continental goods. As to durability, the effects of mordants employed should not be overlooked. Many of the German fabrics, now competing in the home market with our own, by greater apparent cheapness, have the defect of being perfectly rotten through the chemical agents employed to fix on indifferent material brilliant dyes, especially those with a mixture of tints. It is thus not enough that the colors are fast. It must be seen that the different materials employed are not destructive of the filaments. Many a draper loses his customers on this score, and by no fault of his own. A beautiful fabric falls to pieces, or tears at the slightest twitch, simply because the dyeing materials have eaten into its very substance. This is particularly the case with mixed fabrics composed in whole or in part of vegetable fibers.—*From an English Journal.*

A most instructive and interesting report of scientific tests of fabrics may be found in No. 7, Vol. V., of the Bulletin of the National Association of Wool Manufacturers, 1875.

Adulteration of Textile Fabrics.—Mr. Charles Stodder shows, in a recent article in an English scientific journal, that in most cases the microscope is an infallible detective of the admixture of base substances in textile fabrics, and the cases are few in which it fails to be of service.

THE DESTRUCTION OF DYE-TUBS.—The most rapid destruction of wooden dye-houses and dye-tubs is interestingly illustrated in a sim-

ple test. Take separately, in test tubes, a saturated solution of chlorate of lime, potash, soda ash or chrome, and diluted sulphuric acid, say 3 parts water, 1 part acid.

Next, get out seven small sticks (from the same piece of wood), as near alike in size and condition as possible. Number the sticks. Immerse one end of the stick No. 1 in the lime water. No. 2 in the potash liquor. No. 3 in the acid. No. 4, change daily from the lime to potash and back again. No. 5, put into the potash and acid alternately in like manner. No. 6, into the lime and acid. No. 7, alternately into all three. Noting the progress of the influence of the chemicals for about ten days, more tubes may be added to contain the same liquors mixed.

Boiler Incrustation.—G. E. Davis, in dealing with this subject in a recent paper, says that many nostrums had been brought forward as preventives which were absolutely worthless, if not positively injurious. After many trials, he was convinced that as all boiler-scales were principally composed of sulphate of lime, tribasic phosphate of soda, the "tripsa" of commerce, was the best, as it absorbed the carbonic acid in the water, and, acting on the sulphate of lime, precipitated it with the mud to the bottom of the boiler, whence the deposit can be removed easily by frequent blowing off.

Wet Wool Carding.—It is well settled that it is possible to card and spin wet wool; also, that in many cases it is the most economical condition of the wool while carding. But a very few experiments will satisfy any one that wet wool is easily strained, and once strained can never return to its normal state; also that it is quite unnatural for wet wool to draw; furthermore, that if oil be added to the wet wool they cannot unite but will separate, some fibers taking the moisture, others the oil; therefore, however evenly the separation may be distributed the consequence must be inevitable to a greater or less degree, namely twitty yarn. With the very best machinery, wool that is oiled while wet, will not make a perfect thread. In France this point has been carefully considered, and different methods are made use of to remedy the difficulty. First, the last liquor through which the wool passes is so strong that what remains of it in the wool will unite more readily with the oil to be added subsequently. Second, the wool is run through an oil composition after washing; this composition is oil and water thoroughly united. Third, the oil is not added to the wet wool clear, but is first saponified and added to the wool in the form of a composition. This all helps, but does not entirely overcome the diffi-

culties arising from water upon wool, however treated. Back washing, of course, helps the worsted spinner in this respect, if the stock is treated with the point in view. The substitute for oil known as "Temperlana" in England is a great help also, besides having other advantages to commend it.

WORSTED.—The term "worsted" is generally said to be taken from a small town in Norfolk, England, where the manufacture, at one time, was chiefly conducted. Ducange, in his "*Glossarium ad Scriptores mediæ et infimæ Latinitatis*," gives the following etymology: "*Worstede, lana texta, ab oppido Worsted in comitatu Norfolcienci, ejas opificio nobili, sic dicta.*" But the probability would seem to be that the town was called after the trade rather than the trade after the town, for in the oldest documents the place is denominated "Wolstede," the place of wool.

However this may be, the rapid growth, in Bradford and the district which it embraces, of the trade indicated by the word "worsted" has been remarkable, and indeed almost unprecedented. Wool had long been spun by hand in private houses, but it was not till the end of last century that spinning by steam-power was established in Bradford. The first steam-factory in the town was built in the year 1800 by Mr. Henry Ramsbotham, father of the present Mr. H. R. Ramsbotham of Allerton Hall, near Bradford.

The nature and processes of the worsted manufacture may next be described.

Wool is divisible into two great classes, according to the length of its fiber. Speaking generally, we may say that "long" wool is coarser in fiber than "short" wool; but all long wool is not necessarily coarse, nor all short wool fine. The specific difference between them has been held to be somewhat as follows: Examined under the microscope, "short" wool, it is stated, presents the appearance of being serrated and imbricated; in other words, its fibres are notched like a saw, and bent over one another, like tiles overlapping at the edges. In a fiber of merino wool, an inch in length, there are said to be 2,400 of these serrations; in one of Saxony, 2,700; in South Down, 2,080; in Leicester, only 1,860. In "long" wool these saw-like cusps or points are less developed; indeed, in some sorts they are nearly altogether wanting. For the production of woolen cloth that wool is most suitable which possesses the greatest number of these serrations, because it is by means of these that the "felting" process, which is the essence of such cloth, is accomplished. On the other hand, the specialty of

worsted fabrics is, that in them this felting operation is avoided, or takes place only to a very limited extent. Instead of the end to be attained being the uniform matting and interlacing of the fibers, the object is just the opposite, that is to say, the fibers are required to be drawn and spread out separately and evenly. This is done by means of the comb, which, in all its forms, aims at disjointing each separate lock or ringlet of wool, and arranging the fibers longitudinally.

English wool comes to Bradford in large bags packed comparatively loosely. Colonial wool, to save freight by lessening bulk, is made up before shipment in small square bales, packed by hydraulic presses of considerable power, and the wool, subjected to such compression, becomes matted so closely that it cannot easily be opened out. The wool is therefore placed in a sort of oven heated by steam ; speedily the tenacious fibers relax their hold, and the mass is then easily spread out into the form of the original fleece.

This fleece is passed on to the wool-sorter's board. It need scarcely be said that all the wool on a sheep's back is not of the same quality, but varies greatly in length, in fineness and in softness of fibre. The practiced eye of the wool-sorter instantly perceives, and his nimble fingers deftly separate, these varieties, which are thrown into "skeps," or large open wicker baskets, provided for each sort.

The wool, thus "sorted," must next be washed. Iron tanks are provided, full of soap and water, kept by steam constantly at a high temperature. Into these the wool is thrown, and repeatedly drawn through the liquid by iron rakes, which, moved by machinery above, expose it completely to the action of the detergent mixture. The water is then squeezed out by passing the wool between rollers heavily weighted, and the drying process is completed by quickly-revolving fans, or drawing the atmosphere through it.

The raw material is now white and clean. It has next to go through what are called "preparing boxes," in order to separate the fibres and lay them parallel. "Short" wool passes through the carding-machine ("carduus," a thistle, a teazle, was first employed—now, iron wire); "long" wool through "screw-gills," or revolving leather straps armed with fine iron teeth. It is thus made ready for "combing."

It is needful for the production of "yarn" that all the fibers of which each lock or ringlet of wool is composed should be drawn out and laid down smooth and distinct; that the shorter fibers (which are to be found even in the longest wool) should be removed,

and that all extraneous matters—"bits and nibs" the comber calls them—should be got rid of. The operation which accomplishes these ends is appropriately called "combing." It was formerly performed in the houses of the operatives—generally, indeed, in their bed-chambers—and was all done *by hand.* It was necessary that the combs should be heated, and for this purpose they were placed in an earthen-ware stove, or "pot," as it was called, which was kept at a high temperature by burning charcoal in it. The wool was oiled to render it more pliable. The vapors generated by the charcoal were deleterious in the extreme. Nor was the occupation hurtful to the bodily health merely. Dirt and stench produced moral as well as physical degeneracy, and the men sought relief from the nausea of their work-rooms in the excesses of the ale-house. The feeling that there was something essentially wrong in the existence of such a state of things led many of the workers to give a willing ear to agitators, who increased their discontent, and riots occurred on two or three occasions, which rendered it necessary to call in military aid.

So far as wool-combing is concerned, this source of demoralization, happily, no longer exists, and that operation, which was formerly the disgrace, is now the glory of the trade. The combing machines are marvels of ingenuity and even of elegance. Their introduction into Bradford is mainly due to S. C. Lister, Esq. It is necessary that the carded short wool and the long wool not requiring carding should be opened out in the direction of the length of their fibers, and so formed into a "sliver" or ribbon, and that the "noil" or shortest fibers not available for worsted yarn should be taken out. Lightly and gently this operation is effected. Passed under the action of the long thin spikes of the comb, the locks of wool are drawn out in perfectly parallel lines, each "particular hair" not "standing on end," but laid down smooth, sleek and shining, and the "noil" is quietly passed over into its appointed receptacle. And as no mechanical contrivance in the worsted trade is more curious and beautiful, so none has been more beneficent in its moral influence; for, instead of the co-operation of the workman being accompanied, as formerly, by that loss of self-respect which too frequently results from dirty and deleterious labor, it is now rendered by him as the controller of an apparatus thoroughly cleanly and inoffensive in its working, and marvelous in its results. And although the temperature of the combing-shed is still high—averaging seventy degrees—yet the apartment is large and lofty, and ventilation, for the most part, is amply provided for.

The wool, thus combed, is made up into balls called "tops"—a sort of round "heads." It has now to be "prepared" for spinning. This process consists in passing the "slivers," or ribbons, of combed wool between a series of pairs of rollers, moving with regulated and gradually increasing degrees of velocity, and brought, with corresponding gradations, closer to each other, thus diminishing the space between them through which the wool has to move. The result is to draw out the fibers more completely. This is repeated from six to ten times. The strips of slightly-cohering wool thus gain length at the expense of thickness, and are called "rovings;" the word is probably cognate with the sailors' "reefing," from the Anglo-Saxon "reafian," to pull. The bobbins on which these rovings are wound whilst revolving impart a slight amount of twisting to the wool, and a sort of light woolen rope is produced with the smallest possible amount of strain. It is immediately from these "rovings" that "yarn"—literally, "prepared" wool (Anglo-Saxon, "gyrnan," to make ready)—is produced.

The yarn varies according to the quality of the wool from which it is produced, and according to the fineness of thread to which it is spun. In what is called the "fly-frame," for spinning long wool, the spindles have a velocity of 2,500 revolutions per minute. In the "cap-frame" they attain the almost incredible speed of 6,000 per minute, or 100 revolutions per second. The tenuity of the yarn is indicated by the "number," which represents how many skeins, or "hanks"—bundles that one may "hang" up—go into a pound. Thus, "40's" yarn means that in one pound weight there are forty hanks, each measuring 560 yards; "80's" means that in the same weight there are twice as many yards, which must, therefore, be a yarn twice as fine.

Cotton warps were introduced into Bradford in A. D. 1834, and produced a revolution in the manufacture of the district. From this point may be dated the most rapid growth both of the trade and the town. Cotton has some great advantages over wool in its employment as warp; it is stronger, and therefore better fitted to bear the stress of looms worked by steam-power; it is ordinarily spun to a finer thread, and, above all, it is less costly. Its use increased with great rapidity, and probably seven-eighths of the pieces now produced are made with cotton warp. For some of the finest goods silk warps are used.

Weaving, like combing and spinning, was originally a domestic operation, and during the time of transition from hand-looms to power-looms there was a good deal of suffering. The work is now

all but universally carried on in the factories, and at least two-thirds of the weavers are females. The mere manual labor is in itself quite light. Steam supplies the motive power; what the operative has to do is to watch the web in its progress, see that the shuttle is kept supplied with the right yarn, pick out any knots occurring in defective weft, and, if any thread breaks, join it together again. A very ingenious contrivance, called the weft-fork, which stops the motion of the shuttle the instant the weft breaks, has rendered it possible for one weaver to attend to two, and even three, looms with no more trouble than one required formerly. The inventor is a Lancashire operative. In looms for the weaving of yarn-dyed, figured or "fancy" goods, where a variety of colors has to be introduced in the weft, a number of shuttle-boxes are required, each supplying a different-colored thread; the action of all these is automatic. In plain fabrics each weaver generally attends to two looms; in figured goods, for the most part, to one only. The faculties demanded of the weaver are sharp eyes and nimble fingers, and it is patience rather than strength that first becomes exhausted. From the beam on which the piece has in weaving wound itself it is now taken, examined by the overlooker and passed into the hands of the salesman in the warehouse, by whom it is disposed of to the merchant. Pieces undyed are called "gray goods." The dyeing is performed according to the requirements and instructions of the merchants purchasing.

The manufactured goods produced by the operations that have thus been indicated are of great variety. The world is the market for them; there is scarcely a corner of the globe open to British products where they have not penetrated. Speaking generally, they may be divided into two classes, distinguishable according to the "luster" of their surface, or to the "softness" of their "handle." Most of them are used for the dresses of women and children; some for the lining of woolen garments and for men's light summer coats; others for window-hangings and domestic furniture. Many of the names by which the different articles are distinguished were given by the mere fancy or whim of the salesman; others are corruptions of the names of places where the particular goods were first produced. The best names indicate the material employed or the specialty of the fabric itself.—*Extract from an Essay on Bradford and the Worsted Manufacture, by George Taylor.*

Yarn Reels.—These machines are very simple, but they may be too simple. There are reels running in mills at this present time

which cause fully three times more waste in spooling than some others. The writer knows of such reels, working on yarn every pound of which is worth more than one dollar and ten cents; indeed, yarn double that sum in value has often been tangled on these reels. This may be an exceptional case, but it is more likely to be a fair example of many others. The difficulty with these reels is that they are exactly the same as those built twenty years ago for very ordinary yarn. There is no automatic guide motion and movable section bar; one bobbin is run into a skein, or at best, into one-half a skein. So imperfect is the reel and guide that between the wabble of the former and the stationary position of the other the skein is a tangled instead of a free open coil, which may be unwound freely even after dyeing. The most perfect reels can be purchased for less money than the value of the yarn unnecessarily wasted by a poor reel, in less than one year of steady work.

YARN STRETCHING.—Many kinds of yarn, especially worsted, should be subjected to a reasonable strain while drying. When worsted yarn is hung up loose to dry, it loses its luster, and if a little uneven before washing or drying, or both, it becomes more so by the slack way of drying. For the heavier kinds of worsted goods, which should have a cloth feel and appearance, this point is of paramount importance. When yarn has been kept out tight while drying, the goods may be laid out wider in the loom, as they will shrink considerably more than if made of yarn dried slack, but not quite so much as goods made of raw yarns. It is the gain of weight and softness obtained in this way which gives some European goods their special peculiarity. Care must be taken to avoid overdoing. When yarn is wet it is an easy matter to overstrain and weaken it.

Table showing the Equivalent Numbers for the Grain System in Run and Worsted Numbers.

Weight of 20 Yds. in Grns.	Runs, Nos.	Worsted, Nos.
5	17.50	50.
6	14.58	41.66
7	12.50	35.77
8	10.93	31.25
9	9.72	27.77
10	8.75	25.
11	7.95	22.72
12	7.29	20.83
13	6.73	19.23
14	6.25	17.85
15	5.83	16.66
16	5.47	15.62
17	5.14	14.70
18	4.86	13.88
19	4.60	13.15
20	4·37	11.96
25	3.50	10.
30	2.91	8.21
35	2.50	7.14
40	2.18	6.25
45	1.94	5.55
50	1 75	5.
55	1.59	4.54
60	1.45	4.16
65	1.34	3.84
70	1.25	3.57
75	1.16	3.33
80	1.09	3.12
85	1.02	2.94
90	.97	2.77

Table showing Equivalent Numbers for the Run System in the Grain, Cotton and Worsted Nos.

Runs, Nos.	Grains, Nos.	Worsted, Nos.	Cotton, Nos.
$\frac{3}{4}$	$116\frac{2}{3}$	$2\frac{1}{7}$	$1\frac{9}{21}$
1	$87\frac{1}{2}$	$2\frac{6}{7}$	$1\frac{19}{21}$
$1\frac{1}{4}$	70	$3\frac{4}{7}$	$2\frac{8}{21}$
$1\frac{1}{2}$	$58\frac{1}{3}$	$4\frac{2}{7}$	$2\frac{18}{21}$
$1\frac{3}{4}$	50	5	$3\frac{7}{21}$
2	$43\frac{3}{4}$	$5\frac{5}{7}$	$3\frac{17}{21}$
$2\frac{1}{4}$	$38\frac{8}{9}$	$6\frac{3}{7}$	$4\frac{6}{21}$
$2\frac{1}{2}$	35	$7\frac{1}{7}$	$4\frac{15}{21}$
3	$29\frac{1}{6}$	$8\frac{4}{7}$	$5\frac{15}{21}$
$3\frac{1}{2}$	25	10	$6\frac{14}{21}$
4	$21\frac{7}{8}$	$11\frac{3}{7}$	$7\frac{13}{21}$
$4\frac{1}{2}$	$19\frac{4}{9}$	$12\frac{6}{7}$	$8\frac{12}{21}$
5	$17\frac{1}{2}$	$14\frac{2}{7}$	$9\frac{11}{21}$
$5\frac{1}{2}$	$15\frac{10}{11}$	$15\frac{5}{7}$	$10\frac{10}{21}$
6	$14\frac{7}{12}$	$17\frac{1}{7}$	$11\frac{9}{21}$
7	$12\frac{1}{2}$	20	$13\frac{7}{21}$
8	$10\frac{15}{16}$	$22\frac{6}{7}$	$15\frac{5}{21}$
9	$9\frac{13}{18}$	$25\frac{5}{7}$	$17\frac{3}{21}$
10	$8\frac{3}{4}$	$28\frac{4}{7}$	$19\frac{1}{21}$
11	$7\frac{21}{22}$	$31\frac{3}{7}$	$20\frac{20}{21}$
12	$7\frac{7}{24}$	$34\frac{2}{7}$	$22\frac{18}{21}$
13	$6\frac{19}{26}$	$37\frac{1}{7}$	$24\frac{16}{21}$
14	$6\frac{1}{4}$	40	$26\frac{14}{21}$
15	$5\frac{5}{6}$	$42\frac{6}{7}$	$28\frac{12}{21}$
16	$5\frac{15}{32}$	$45\frac{5}{7}$	$30\frac{10}{21}$
17	$5\frac{5}{34}$	$48\frac{4}{7}$	$32\frac{8}{21}$
18	$4\frac{31}{36}$	$51\frac{3}{7}$	$34\frac{6}{21}$
19	$4\frac{23}{38}$	$54\frac{2}{7}$	$36\frac{4}{21}$
20	$4\frac{3}{8}$	$57\frac{1}{7}$	$38\frac{2}{21}$
21	$4\frac{1}{6}$	60	40

Table showing Equivalent No. for Worsted System in Run and Cotton Nos.

Worsted, Nos.	Cotton, Nos.	Runs, Nos.
10	$6\frac{2}{3}$	$3\frac{5}{10}$
12	8	$4\frac{2}{10}$
14	$9\frac{1}{3}$	$4\frac{9}{10}$
15	10	$5\frac{1}{4}$
16	$10\frac{2}{3}$	$5\frac{6}{10}$
18	12	$6\frac{3}{10}$
20	$13\frac{1}{3}$	7
22	$14\frac{2}{3}$	$7\frac{7}{10}$
24	16	$8\frac{4}{10}$
26	$17\frac{1}{3}$	$9\frac{1}{10}$
28	$18\frac{2}{3}$	$9\frac{7}{10}$
30	20	$10\frac{5}{10}$
32	$21\frac{1}{3}$	$11\frac{2}{10}$
36	24	$12\frac{6}{10}$
40	$26\frac{2}{3}$	14
44	$29\frac{1}{3}$	$15\frac{4}{10}$
48	32	$16\frac{8}{10}$
50	$33\frac{1}{3}$	$17\frac{5}{10}$
56	$37\frac{1}{3}$	$19\frac{6}{10}$
60	40	21
64	$42\frac{2}{3}$	$22\frac{4}{10}$
70	$46\frac{2}{3}$	$24\frac{5}{10}$
72	48	$25\frac{2}{10}$
80	$56\frac{2}{3}$	28
90	60	$31\frac{5}{10}$
100	$66\frac{2}{3}$	35
110	$73\frac{1}{3}$	$38\frac{5}{10}$
120	80	42
140	$93\frac{1}{3}$	49
150	100	$52\frac{5}{10}$

Table Showing Threads per Inch, Width of Warp in Reeds, and Total Number of Threads.

Thds. per Inch.	Width in Reed, 60 Ins.	Width in Reed, 61 Ins.	Width in Reed, 62 Ins.	Width in Reed, 63 Ins.	Width in Reed, 64 Ins.	Width in Reed, 65 Ins.	Width in Reed, 66 Ins.	Width in Reed, 67 Ins.	Width in Reed, 68 Ins.	Width in Reed, 69 Ins.
	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.
12...	720	732	744	756	768	780	792	804	816	828
14...	840	854	868	882	896	910	924	938	952	966
15...	900	915	930	945	960	975	990	1005	1020	1035
16...	960	976	992	1008	1024	1040	1056	1072	1088	1104
18...	1080	1098	1116	1134	1152	1170	1188	1206	1224	1242
20...	1200	1220	1240	1260	1280	1300	1320	1340	1360	1380
21...	1260	1281	1302	1323	1344	1365	1366	1407	1428	1449
22...	1320	1342	1364	1386	1408	1430	1452	1474	1496	1518
24...	1440	1464	1488	1512	1536	1560	1584	1608	1632	1656
25...	1500	1525	1550	1575	1600	1625	1650	1675	1700	1725
26...	1560	1586	1612	1638	1664	1690	1716	1742	1768	1794
27...	1620	1647	1674	1701	1728	1755	1782	1709	1836	1863
28...	1680	1708	1736	1764	1792	1820	1848	1876	1904	1932
30...	1800	1830	1860	1890	1920	1950	1980	2010	2040	2070
32...	1920	1952	1934	2016	2048	2080	2112	2144	2176	2208
33...	1980	2013	2046	2079	2112	2145	2178	2211	2244	2277
34...	2040	2074	2108	2142	2176	2210	2244	2278	2312	2346
35...	2100	2135	2170	2205	2240	2275	2310	2345	2380	2415
36...	2160	2196	2232	2268	2304	2340	2376	2412	2448	2484
38...	2280	2318	2356	2394	2432	2470	2508	2546	2584	2622
39...	2340	2379	2418	2457	2496	2535	2574	2613	2652	2691
40...	2400	2440	2480	2520	2560	2600	2640	2680	2720	2760
42...	2520	2562	2604	2646	2688	2730	2772	2814	2856	2898
44...	2640	2684	2728	2772	2816	2860	2904	2948	2992	3036
45..	2700	2745	2790	2835	2880	2925	2970	3025	3060	3105
46...	2760	2806	2852	2898	2944	2990	3036	3082	3128	3174
48...	2880	2928	2976	3024	3072	3120	3168	3216	3264	3312
49...	2940	2989	3038	3087	3136	3185	3234	3283	3332	3381
50...	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450
52...	3120	3172	3224	3276	3328	3380	3432	3484	3536	3588
54...	3240	3294	3348	3402	3456	3510	3564	3618	3672	3726
55..	3300	3355	3410	3465	3520	3575	3630	3685	3740	3795
56..	3360	3416	3472	3528	3584	3640	3696	3752	3808	3864
58...	3480	3538	3596	3654	3712	3770	3828	3886	3944	4002
60...	3600	3660	3720	3780	3840	3900	3960	4020	4080	4140
62..	3720	3782	3844	3906	3968	4030	4092	4154	4216	4278
63...	3780	3843	3906	3969	4032	4095	4158	4221	4284	4347
64...	3840	3904	3968	4032	4096	4160	4224	4288	4352	4416
65...	3900	3965	4030	4095	4160	4225	5290	4355	4420	4485
66...	3960	4026	4092	4158	4224	4290	4356	4422	4488	4554
68...	4080	4148	4216	4284	4352	4420	4488	4556	4624	4692
70...	4200	4270	4340	4410	4480	4550	4620	4690	4760	4830
72...	4320	4392	4464	4536	4608	4680	4752	4824	4896	4968
74...	4440	4514	4588	4662	4736	4810	4884	4958	5032	5106

Table Showing Threads per Inch, Width of Warp in Reed, and Total Number of Threads.

Thds. per Inch.	Width in Reed, 70 Ins.	Width in Reed, 72 Ins.	Width in Reed, 74 Ins.	Width in Reed, 76 Ins.	Width in Reed, 78 Ins.	Width in Reed, 80 Ins.	Width in Reed, 82 Ins.	Width in Reed, 85 Ins	Width in Reed, 87 Ins.	Width in Reed, 90 Ins.
	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.
12...	840	864	888	912	936	960	984	1020	1044	1080
14...	980	1008	1036	1064	1092	1120	1148	1190	1218	1260
15...	1050	1080	1110	1140	1170	1200	1230	1275	1305	1350
16...	1120	1152	1184	1216	1248	1280	1312	1360	1392	1440
18...	1260	1296	1332	1368	1404	1440	1476	1530	1566	1620
20...	1400	1440	1480	1520	1560	1600	1640	1700	1740	1800
21...	1470	1512	1554	1596	1638	1680	1722	1785	1827	1890
22...	1540	1584	1628	1672	1716	1760	1804	1870	1914	1980
24...	1680	1728	1776	1824	1872	1920	1968	2040	2088	2160
25...	1750	1800	1850	1900	1950	2000	2050	2125	2175	2250
26...	1820	1872	1924	1976	2028	2080	2132	2210	2262	2340
27...	1890	1944	1998	2052	2106	2160	2214	2295	2349	2430
28...	1960	2016	2072	2128	2184	2240	2296	2380	2436	2520
30...	2100	2160	2220	2280	2340	2400	2460	2550	2610	2700
32...	2240	2304	2368	2432	2496	2560	2624	2720	2784	2880
33...	2310	2376	2442	2508	2574	2640	2706	2805	2871	2970
34...	2380	2448	2516	2584	2652	2720	2788	2890	2958	3060
35...	2450	2520	2590	2660	2730	2800	2870	2975	3045	3150
36...	2520	2592	2664	2736	2808	2880	2952	3060	3132	3240
38...	2660	2736	2812	2888	2964	3040	3116	3230	3306	3420
39...	2730	2808	2886	2964	3042	3120	3198	3315	3393	3510
40...	2800	2880	2960	3040	3120	3200	3280	3400	3480	3600
42...	2940	3024	3108	3192	3276	3360	3444	3570	3654	3780
44...	3080	3168	3256	3344	3432	3520	3608	3740	3828	3960
45...	3150	3240	3330	3420	3510	3600	3690	3825	3915	4050
46...	3220	3312	3404	3496	3588	3680	3772	3910	4002	4140
48...	3360	3456	3552	3648	3744	3840	3936	4080	4176	4320
49...	3430	3528	3626	3724	3822	3920	4018	4165	4263	4410
50...	3500	3600	3700	3800	3900	4000	4100	4250	4350	4500
52...	3640	3744	3848	3952	4056	4160	4264	4420	4524	4680
54...	3780	3888	3996	4104	4212	4320	4428	4590	4698	4860
55 ..	3850	3960	4070	4180	4290	4400	4510	4675	4785	4950
56...	3920	4032	4144	4256	4368	4480	4592	4760	4872	5040
58...	4060	4176	4292	4408	4524	4640	4756	4930	5046	5220
60...	4200	4320	4440	4560	4680	4800	4920	5100	5220	5400
62...	4340	4464	4588	4712	4836	4960	5084	5270	5394	5580
63...	4410	4536	4662	4788	4914	5040	5166	5355	5481	5670
64...	4480	4608	4736	4864	4992	5120	5248	5440	5568	5760
65...	4550	4680	4810	4940	5070	5200	5330	5525	5655	5850
66...	4620	4752	4884	5016	5148	5280	5412	5610	5742	5940
68...	4760	4896	5032	5168	5304	5440	5576	5780	5916	6120
70...	4900	5040	5180	5320	5460	5600	5740	5950	6090	6300
72...	5040	5184	5328	5472	5616	5760	5904	6120	6264	6480
74...	5180	5328	5476	5624	5772	5920	6068	6290	6438	6660

Table Showing Threads per Inch, Width of Warp in Reeds, and Total Number of Threads.

Thds. per Inch.	Width in Reed, 60 Ins.	Width in Reed, 61 Ins.	Width in Reed, 62 Ins.	Width in Reed, 63 Ins.	Width in Reed, 64 Ins.	Width in Reed, 65 Ins.	Width in Reed, 66 Ins.	Width in Reed, 67 Ins.	Width in Reed, 68 Ins.	Width in Reed, 69 Ins.
	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.
75...	4500	4575	4650	4723	4800	4873	4950	5025	5100	5175
76...	4560	4636	4712	4788	4864	4940	5016	5092	5168	5244
78...	4680	4758	4836	4914	4992	5070	5148	5226	5304	5382
80...	4800	4880	4960	5040	5120	5200	5280	5360	5440	5520
81...	4860	4941	5022	5103	5184	5265	5346	5427	5508	5589
82...	4920	5002	5084	5166	5248	5330	5412	5494	5576	5658
84.	5040	5124	5208	5292	5376	5460	5544	5628	5712	5796
85...	5100	5185	5270	5355	5440	5525	5610	5695	5780	5865
86...	5160	5246	5332	5418	5504	5590	5676	5762	5848	5934
88...	5280	5368	5456	5544	5632	5720	5808	5896	5984	6072
90...	5400	5490	5580	5670	5760	5850	5940	6030	6120	6210
92..	5520	5612	5704	5796	5888	5980	6072	6164	6256	6348
93...	5580	5673	5766	5859	5952	6045	6138	6231	6324	6417
94...	5640	5734	5828	5922	6016	6110	6204	6298	6392	6486
95...	5700	5795	5890	5985	6080	6175	6270	6365	6460	6555
96...	5760	5856	5952	6048	6144	6240	6336	6432	6528	6624
98...	5880	5978	6076	6174	6272	6370	6468	6566	6664	6762
99...	5940	6039	6138	6237	6336	6435	6534	6633	6732	6831
100...	6000	6100	6200	6300	6400	6500	6600	6700	6800	6900
102...	6120	6222	6324	6426	6528	6630	6732	6834	6936	7038
104...	6240	6344	6448	6552	6656	6760	6864	6968	7072	7176
105...	6300	6405	6510	6615	6720	6825	6930	7035	7140	7245
106...	6360	6466	6572	6678	6784	6890	6996	7102	7208	7314
108...	6480	6588	6696	6804	6912	7020	7128	7236	7344	7452
110..	6600	6710	6820	6930	7040	7150	7260	7370	7480	7590
112...	6720	6832	6944	7056	7168	7280	7392	7504	7616	7728
116...	6960	7076	7192	7308	7424	7540	7656	7772	7888	8004
120...	7200	7320	7440	7560	7680	7800	7920	8040	8160	8280
122...	7320	7442	7564	7686	7808	7930	8052	8174	8296	8418
124...	7440	7564	7688	7812	7936	8060	8184	8308	8432	8556
126...	7560	7686	7812	7938	8064	8190	8316	8442	8568	8694
128...	7680	7808	7936	8064	8192	8320	8448	8576	8704	8832
130..	7800	7930	8060	8190	8320	8450	8580	8710	8840	8970
132...	7920	8052	8184	8316	8448	8580	8712	8844	8976	9108
133...	7980	8113	8246	8379	8512	8645	8778	8911	9044	9177
135..	8100	8235	8370	8505	8640	8775	8910	9045	9180	9315
136 ..	8160	8296	8432	8568	8704	8840	8976	9112	9248	9384
140...	8400	8540	8680	8820	8960	9100	9240	9380	9520	9660
144...	8640	8784	8928	9072	9216	9160	9504	9648	9792	9936
148...	8880	9028	9176	9324	9472	9620	9768	9916	10164	10212
150...	9000	9150	9300	9450	9600	9750	9900	10050	10200	10350
160...	9600	9760	9920	10080	10240	10400	10560	10720	10880	11040
180...	10800	10980	11160	11340	11520	11700	11880	12060	12240	12420
200...	12000	12200	12400	12600	12800	13000	13200	13400	13600	13800

Table Showing Threads per Inch, Width of Warp in Reed, and Total Number of Threads.

Thds. per Inch.	Width in Reed, 70 Ins.	Width in Reed, 72 Ins.	Width in Reed, 74 Ins.	Width in Reed, 76 Ins.	Width in Reed, 78 Ins.	Width in Reed, 80 Ins.	Width in Reed, 82 Ins.	Width in Reed, 85 Ins.	Width in Reed, 87 Ins.	Width in Reed, 90 Ins.
	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.	Thds.
75...	5250	5400	5550	5700	5850	6000	6150	6375	6525	6750
76...	5320	5472	5624	5776	5928	6080	6232	6460	6612	6840
78...	5460	5616	5772	5928	6084	6240	6396	6630	6786	7020
80 ..	5600	5760	5920	6080	6240	6400	6560	6800	6960	7200
81...	5670	5832	5994	6156	6318	6480	6642	6885	7047	7290
82...	5740	5904	6068	6232	6396	6560	6724	6970	7134	7380
84...	5880	6048	6216	6384	6552	6720	6888	7140	7308	7560
85...	5950	6120	6290	6460	6630	6800	6970	7225	7395	7650
86...	6020	6192	6364	6536	6708	6880	7052	7310	7482	7740
88...	6160	6336	6512	6688	6864	7040	7216	7480	7656	7920
90...	6300	6480	6660	6840	7020	7200	7380	7650	7830	8100
92...	6440	6624	6808	6992	7176	7360	7544	7820	8004	8280
93...	6510	6696	6882	7068	7254	7440	7626	7905	8091	8370
94...	6580	6768	6956	7144	7332	7520	7708	7990	8178	8460
95...	6650	6840	7030	7220	7410	7600	7790	8075	8265	8550
96...	6720	6912	7104	7296	7488	7680	7872	8160	8352	8640
98..	6860	7056	7252	7448	7644	7840	8036	8330	8526	8820
99...	6930	7128	7326	7524	7722	7920	8118	8415	8613	8910
100...	7000	7200	7400	7600	7800	8000	8200	8500	8700	9000
102...	7140	7344	7548	7752	7956	8160	8364	8670	8874	9180
104...	7280	7488	7696	7904	8112	8320	8528	8840	9048	9360
105...	7350	7560	7770	7980	8190	8400	8610	8925	9135	9450
106...	7420	7632	7844	8056	8268	8480	8692	9010	9222	9540
108...	7560	7776	7992	8208	8424	8640	8856	9180	9396	9720
110...	7700	7920	8140	8360	8580	8800	9020	9350	9570	9900
112...	7840	8064	8288	8512	8736	8960	9184	9520	9744	10080
116...	8120	8352	8584	8816	9048	9280	9512	9860	10092	10440
120...	8400	8640	8880	9120	9360	9600	9840	10200	10440	10800
122...	8540	8784	9028	9272	9516	9760	10004	10370	10614	10980
124...	8680	8928	9176	9424	9672	9920	10168	10540	10788	11160
126...	8820	9072	9324	9576	9828	10080	10332	10710	10962	11340
128...	8960	9216	9472	9728	9984	10240	10496	10880	11136	11520
130...	9100	9360	9620	9880	10140	10400	10660	11050	11310	11700
132...	9240	9504	9768	10032	10296	10560	10824	11220	11484	11880
133...	9310	9576	9842	10108	10374	10640	10906	11305	11571	11970
135...	9450	9720	9990	10260	10530	10800	11070	11475	11745	12150
136...	9520	9792	10064	10336	10608	10880	11152	11560	11832	12240
140...	9800	10080	10360	10640	10920	11200	11480	11900	12180	12600
144...	10080	10368	10656	10944	11222	11520	11808	12340	12628	12960
148..	10360	10656	10952	11248	11544	11840	12136	12580	12876	13320
150...	10500	10800	11100	11400	11700	12000	12300	12750	13050	13500
160...	11200	11520	11840	12160	12480	12800	13120	13600	13920	14400
180...	12600	12960	13320	13680	14040	14400	14760	15300	15660	16200
200...	14000	14400	14800	15200	15600	16000	16400	17000	17400	18000

TABLE SHOWING THE WEIGHT OF ONE HUNDRED YARDS OF WARP YARN (WOOLEN,) IN POUNDS AND OUNCES.

1 R.		1¼ R.		1½ R.		1¾ R.		2 R.		2¼ R.		2⅜ R.		2¾ R.		3 R.		3⅜ R.		4 R.		4½ R.		5 R.		5⅜ R.		Thr' ds.
Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	
	1		.80		.67		.57		.50		.44		.40		.36		.33		.28		.25		.22		.20		.18	1
	2		1.60		1.33		1.14		1.00		.89		.80		.73		.67		.57		.50		.44		.40		.36	2
	3		2.40		2.00		1.71		1.50		1.33		1.20		1.09		1.00		.85		.75		.66		.60		.54	3
	4		3.20		2.67		2.28		2.00		1.77		1.60		1.45		1.33		1.17		1.00		.88		.80		.73	4
	5		4.00		3.33		2.85		2.50		2.22		2.00		1.82		1.67		1.42		1.25		1.11		1.00		.91	5
	6		4.80		4.00		3.42		3.00		2.66		2.40		2.18		2.00		1.71		1.50		1.33		1.20		1.09	6
	7		5.60		4.67		4.00		3.50		3.11		2.80		2.54		2.33		2.00		1.75		1.55		1.40		1.27	7
	8		6 40		5.33		4.57		4.00		3.55		3.20		2.91		2.67		2.28		2.00		1.77		1.60		1.45	8
	9		7.20		6.00		5.14		4.50		4.00		3.60		3.27		3.00		2.57		2.25		2.00		1.80		1.64	9
	10		8.00		6.67		5.71		5.00		4.44		4.00		3.64		3.33		2.85		2.50		2.22		2.00		1.82	10
1	4	1	....		13.33		11.42		10.00		8.88		8.00		7.27		6.67		5.71		5.00		4.44		4.00		3.64	20
1	14	1	8.00	1	4.00	1	1.14		15.00		13.33		12.00		10.91		10.00		8.57		7.50		6.66		6.00		5.45	30
2	8	2	....	1	10.67	1	6.85	1	4.00	1	1.77	1	....		14.64		13.33		11.42		10.00		8.88		8.00		7.27	40
3	2	2	8.00	2	1.33	1	12.57	1	9.00	1	6.22	1	4.00	1	2.27	1	.67		14.28		12.50		11.11		10.00		9.09	50
3	12	3	....	2	8.00	2	2.28	2	3.00	1	10.66	1	8.00	1	5.91	1	4.00	1	1.14		15.00		13.33		12.00		10.91	60
4	6	3	8.00	2	14.67	2	6.00	2	13.00	1	15.11	1	12.00	1	9.54	1	7.33	1	4.00	1	1.50		15.55		14.00		12.73	70
5	...	4	....	3	5.33	2	11.71	3	7.00	2	3.55	2	....	1	13.18	1	10.66	1	6.85	1	4.00	1	1.77	1	....		14.54	80
5	10	4	8.00	3	12.00	3	1.42	4	1.00	2	8.00	2	4.00	2	.82	1	14.00	1	9.71	1	6.50	1	4.00	1	2.00	1	.36	90
6	4	5	....	4	2.69	3	9.14	3	2.00	2	12.44	2	8.00	2	4.36	2	1.33	1	12.57	1	9.00	1	6.22	1	4.00	1	2.18	100
12	8	10	....	8	5.33	7	2.28	6	4.00	5	8.88	5	....	4	8.73	4	2.67	3	9.14	3	2.00	2	12.44	2	8.00	2	4.36	200
18	12	15	...	12	8.00	10	11.42	9	6.00	8	5.33	7	8.00	6	13.09	6	4.00	5	5.71	4	11.00	4	2.66	3	12.00	3	6.54	300
25	....	20	...	16	10.67	14	4.57	12	8.00	11	1.77	10	....	9	1.45	8	5.33	7	1.28	6	4.00	5	8.88	5	....	4	8.73	400
31	4	25	....	20	13.33	17	13.71	15	10.00	13	14.22	12	8.00	11	5.82	10	6.67	8	13.85	7	13.00	6	15.11	6	4.00	5	10.91	500
37	8	30	....	25	....	21	6.85	18	12.00	16	10.66	15	....	13	10.18	12	8.00	10	11.42	9	6.00	8	5.33	7	8.00	6	13.09	600
43	12	35	....	29	2.67	25	....	21	14.00	19	7.11	17	8.00	15	14.54	14	9.33	12	8.00	10	15.00	9	11.55	8	12.00	7	15.27	700
50	....	40	....	33	5.33	28	9.14	25	....	22	3.55	20	....	18	2.91	16	10.67	14	4.57	12	8.00	11	1.77	10	....	9	1.45	800
56	4	45	.. .	37	8.00	32	2.28	28	2.00	25	....	22	8.00	20	7.27	18	12.00	16	1.14	14	1.00	12	8.00	11	4.00	10	3.64	900
62	8	50	....	41	10.67	35	11.42	31	4.00	27	12.44	25	....	22	11.64	20	13.33	17	13.71	15	10.00	13	14.22	12	8.00	11	5.82	1000
125	....	100	....	83	5.33	71	6.85	62	8.00	55	8.88	50	....	45	7.27	41	10.67	35	11.42	31	4.00	27	12.44	25	....	22	11.64	2000
187	8	150	...	125	....	107	2.28	93	12.00	83	5.33	75	....	68	2.91	62	8.00	53	9.14	46	14.00	41	10.66	37	8.00	34	1.45	3000
250	....	200	....	166	10.67	142	13.71	125	....	111	1.77	100	....	90	14.54	83	5.33	71	6.85	62	8.00	55	8.88	50	....	45	7.27	4000
...	....	250	....	208	5.33	178	9.14	156	4.00	138	14.22	125	....	113	10.18	104	2.67	89	4.57	78	2.00	69	7.11	62	8.00	56	13.09	5000
...	....	...	....	250	....	214	4.57	187	8.00	166	10.66	150	....	136	5.82	125	....	107	2.28	93	12.00	83	5.33	75	....	68	2.91	6000
...	....	...	....	...	....	250	....	218	12.00	194	7.11	175	....	159	1.45	145	13.33	125	....	109	6.00	97	3.55	87	8.00	79	8.73	7000
...	....	...	....	...	....	...	....	250	....	222	3.55	200	....	181	12.09	166	10.67	142	13.71	125	....	111	1.77	100	....	90	14.54	8000
...	....	...	....	...	....	...	....	...	....	250	....	225	..	204	7.73	187	8.00	160	11.42	140	10.00	125	....	112	8.00	102	4.36	9000
...	....	...	....	...	....	...	....	...	....	...	....	250	....	227	3.57	208	5.33	178	9.14	156	4.00	138	14.22	125	....	113	10.18	10.000

TABLE SHOWING THE WEIGHT OF ONE HUNDRED YARDS OF WARP YARN (WOOLEN,) IN POUNDS AND OUNCES.

6 R. Lbs.	6 R. Oz.	6¼ R. Lbs.	6¼ R. Oz.	6¾ R Lbs.	6¾ R Oz.	7 R. Lbs.	7 R. Oz.	7¼ R. Lbs.	7¼ R. Oz.	Thr'ds.
	0.16		0.16		0.15		0 14		0.14	1
	0.24		0.32		0.32		0.3		0.3	2
	0.5		0.48		0.44		0.43		0.41	3
	0.66		0.64		0.59		0.57		0.55	4
	0.83		0.8		0.74		0.71		0.69	5
	1		0 96		0.88		0.85		0.82	6
	1.16		1.12		1.03		1		0.96	7
	1.33		1.28		1.18		1.14		1.1	8
	1.5		1.44		1.34		1.29		1.23	9
	1.66		1.6		1.47		1.43		1.38	10
	3.33		3.2		2.95		2.87		2.77	20
	5		4.8		4.44		4.28		4.13	30
	6.66		6.4		5.92		5.71		5.51	40
	8.33		8		7.4		7.14		6.88	50
	10		9.6		8.88		8.57		8.27	60
	11.6		11.2		10.3		10		9.65	70
	13.3		12.8		11.8		11.4		11	80
	15		14.4		13.3		12.8		12.4	90
1	.66	1	—		14.8		14.3		13 7	100
2	1.3	2	—	1	13.6	1	12.5	1	11.5	200
3	2	3	—	2	12.4	2	10.8	2	9.31	300
4	2.66	4	—	3	11.2	3	9.16	3	7	400
5	3.33	5	—	4	10	4	7.45	4	4.87	500
6	4	6	—	5	8.86	5	5174	5	2.43	600
7	4.66	7	—	6	7.67	6	4.03	6	0.4	700
8	5.33	8	—	7	6.48	7	2.32	6	14.1	800
9	6	9	—	8	5.29	8	0.61	7	11.9	900
10	6.66	10	—	9	4.11	8	14.86	8	9.7	1000
20	13.3	20	—	18	8.21	17	13.8	17	3.42	2000
31	4	30	—	27	12.3	26	12.7	25	13.1	3000
41	10.6	40	—	37	0.43	35	11.6	34	6.83	4000
52	1.33	50	—	46	4.55	45	4.55	43	0.54	5000
62	8	60	—	55	8.65	53	9.46	51	10.2	6000
72	14 6	70	—	64	12.7	62	8.36	60	5.51	7000
83	5.33	80	—	74	1.16	71	6.89	68	15.4	8000
93	12	90	—	83	5.13	80	5.65	77	9.13	9000
104	2.66	100	—	92	9.48	89	4.54	86	3.32	10.000

7½ R. Lbs.	7½ R. Oz.	7¾ R. Lbs.	7¾ R. Oz.	8 R. Lbs.	8 R. Oz.	8¼ R. Lbs.	8¼ R. Oz.	8½ R. Lbs.	8½ R. Oz.	Thr'ds.
	0.13		0.13		0.13		0.13		0.12	1
	0.28		0.28		0.25		0.25		0.23	2
	0.4		0.38		0.37		0.36		0.35	3
	0.53		0.51		0.5		0.48		0.47	4
	0.66		0.64		0.62		0.6		0.58	5
	0.8		0.77		0.74		0.72		0 7	6
	0.93		0 91		0.87		0.85		0.83	7
	1.06		1 02		1		0.97		0.94	8
	1.2		1.15		1.12		1.09		1.06	9
	1.33		1.28		1.25		1.21		1.18	10
	2.67		2.57		2.50		2.43		2.37	20
	4		3.87		3.75		3.63		3.53	30
	5.33		5.16		5		4.84		4.70	40
	6.45		6.25		6.06		5.88		5.71	50
	8		7.74		7.5		7.27		7.06	60
	9.33		9.03		8.75		8.48		8.23	70
	10.6		10.3		10		9.69		9 41	80
	12		11.6		11.2		10.9		10.5	90
	13.3		12 9		12.5		12.1		11.7	100
1	10 6	1	9.8	1	9	1	8.2	1	7.4	200
2	8	2	6.8	2	5.5	2	4.36	2	3.11	300
3	5.33	3	3.73	3	2	3	48	2	15	400
4	2.66	4	66	3	14.5	3	12.6	3	10.5	500
5		4	13.6	4	11	4	8.72	4	6.2	600
5	13.3	5	10.5	5	7.5	5	4 84	5	19	700
6	10.6	6	7.46	6	4	6	0.96	5	13.6	800
7	8	7	4 33	7	0.5	6	12.9	6	9.33	900
8	5.33	8	1 33	7	13	7	9.2	7	5.6	1000
16	10.6	16	2.66	15	10	15	2.42	14	11.3	2000
25		24	4	23	7	22	11.6	22	0.94	3000
33	5.33	32	5.33	31	4	30	4.83	29	6.59	4000
41	10.6	40	6 66	39	1	37	14	36	12.2	5000
50		48	8	46	14	45	72.6	44	1.89	6000
58	5.33	56	9.33	54	11	53	0.47	51	7.5	7000
66	10.6	64	10.6	62	8	60	9.68	58	13.1	8000
75		72	12	70	5	68	2.89	66	2.81	9000
83	5 33	80	13 3	78	2	75	12.1	73	8.49	10.000

8¾ R. Lbs.	8¾ R. Oz.	9 R. Lbs.	9 R. Oz.	9¼ R. Lbs.	9¼ R. Oz	9½ R. Lbs.	9½ R. Oz.	9¾ R. Lbs.	9¾ R. Oz.	Thr'ds.
	0.12		0.11		0.1		0.1		0.1	1
	0.22		0.22		0.21		0.21		0.21	2
	0.34		0.33		0.32		0.31		0.3	3
	0.45		0.45		0.43		0.42		0.41	4
	0.57		0.55		0.54		0.52		0.51	5
	0.68		0.66		0.64		0.63		0.61	6
	0.8		0.78		0.75		0.73		0.72	7
	0.91		0.89		0.86		0.84		0.82	8
	1.03		1		0.97		0.95		0.92	9
	1.14		1.11		1.08		1.05		1.02	10
	2.29		2.22		2.17		2.11		2.05	20
	3.43		3.33		3.24		3.15		3.07	30
	4.57		4.44		4.32		4.21		4.1	40
	5.66		5.55		5.4		5.26		5.12	50
	6.85		6.66		6.48		6.31		6.15	60
	8		7.77		7.56		7.37		7.18	70
	9 14		8.88		8.64		8.42		8.2	80
	10.3		10		9.73		9 47		9.23	90
	11.4		11.1		10.8		10.5		10.2	100
1	6.8	1	6.2	1	5.61	1	5.4	1	4.4	200
2	2.26	2	1.11	2	.43	1	15.5	1	14.6	300
2	13.7	2	12.4	2	11.2	2	10.8	2	8.8	400
3	9.1	3	7.55	3	6.05	3	4.6	3	3	500
4	4.52	4	2.66	4	0.86	3	15.1	3	13.2	600
4	15.9	4	13.7	4	11.6	4	9.64	4	7.4	700
5	11.3	5	8.88	5	6.48	5	4.16	5	1.6	800
6	6.78	6	3.99	6	1.29	5	14.6	5	11.8	900
7	2.28	6	15.1	6	12.1	6	9.27	6	6.55	1000
14	4.56	13	14.2	13	8.21	13	2.54	12	13	2000
21	6.84	20	13 3	20	4.31	19	11.78	19	3 55	3000
28	9.12	27	12.4	27	0.43	26	5.08	25	10.2	4000
35	11.4	34	11.5	33	12.5	32	14.3	32	0.75	5000
42	13.6	41	10.6	40	8.6	39	7.62	38	7.38	6000
50		48	9.77	47	4 77	46	0.89	44	13.9	7000
57	2.28	55	8 88	54	.88	52	10.1	51	4.51	8000
64	4.57	62	7.99	60	12.9	59	3.43	57	11	9000
71	6.85	69	7.11	67	9.11	65	12.7	64	1.64	10.000

TABLE SHOWING THE WEIGHT OF ONE HUNDRED YARDS OF WARP YARN (WOOLEN,) IN POUNDS AND OUNCES.

10 R.		10¼ R.		10½ R.		10¾ R.		11 R.		11½ R.		12 R.		12½ R.		13 R.		13½ R.		14 R.		14½ R.		15 R.		15½ R.		16 R.		Thr'ds.
Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	
	0.1		0.09		0.09		0.09		0.09		0.09		0.08		0.08		0.08		0.07		0.07		0.07		0.06		0 06		0 06	1
	0.2		0.19		0.19		0.18		0.18		0.18		0.17		0.16		0.16		0.15		0.14		0.14		0.13		0.13		0.12	2
	0.3		0.29		0.28		0.27		0.27		0.26		0.26		0.24		0.23		0.22		0.21		0.20		0.20		0.19		0.18	3
	0.4		0.39		0.38		0.37		0.37		0.35		0.35		0.32		0.31		0.30		0.28		0.27		0.26		0.25		0.25	4
	0.5		0.49		0.48		0.47		0.45		0.44		0.43		0.40		0.38		0.37		0.35		0.34		0.33		0 32		0.31	5
	0.6		0.58		0.57		0.56		0.54		0.52		0.51		0.48		0.46		0.45		0.43		0.41		0.40		0.39		0.37	6
	0.7		0.68		0.67		0 65		0.63		0.62		0.61		0.56		0.54		0.52		0.50		0.48		0.46		0.45		0.44	7
	0.8		0.78		0.76		0.75		0.73		0.71		0.70		0.64		0.62		0.60		[illegible]		0.55		0.53		0.52		0.50	8
	0.9		0.88		0.86		0.84		0.82		0.79		0.78		0.72		0.69		0 67		[illegible]		0.61		0.60		0.59		0.56	9
	1		0.97		0 95		0.93		0.91		0.87		0.86		0.80		0.77		0.75		0.71		0.68		0.67		0.65		0.63	10
	2		1.95		1 91		1.86		1.82		1.75		1.73		1.60		1.55		1.50		1.42		1.37		1.35		1.30		1.25	20
	3		2.93		2.88		2.79		2.72		2.60		2.50		2.40		2.30		2.24		2.14		2.06		2.00		1.94		1.87	30
	4		3.90		3.84		3.72		3.63		3.47		3.33		3.20		3.07		2.99		2.85		2.75		2.67		2.58		2.50	40
	5		4.88		4.81		4.65		4.54		4.34		4.16		4.00		3.84		3.74		3.57		3.44		3.33		3.22		3.12	50
	6		5.85		5.77		5.58		5.45		5.21		5.00		4.80		4.61		4.48		4.28		4.13		4.00		3.88		3.75	60
	7		6.83		6.73		6.51		6 36		6.08		5.83		5.60		5.38		5.23		5.00		4.72		4.66		4.52		4.37	70
	8		7.80		7.69		7.44		7.27		6.95		6.66		6.40		6 15		5.98		5.71		5.51		5.33		5.17		5.00	80
	9		8.78		8.65		8.37		8.18		7.82		7.50		7.20		6.92		6.62		6.43		6.20		6.00		5.81		5.63	90
	10		9.75		9.62		9.32		9.09		8.69		8.33		8.00		7.69		7.48		7.14		6.89		6.66		6.46		6.25	100
1	4	1	3.50	1	3.25	1	2.60	1	2.18	1	1.38	1	0.66	1	....		15.30		14.90		14.30		13.80		13.30		12.90		12.50	200
1	14	1	1.33	1	12.80	1	11.90	1	11.20	1	10.00	1	9.00	1	8	1	7.07	1	6.44	1	5.42	1	4.69	1	4.00	1	3.38	1	2.75	300
2	8	2	7.02	2	6.47	2	5.30	2	4.33	2	2.77	2	1.33	2	....	1	14.70	1	13.90	1	12.50	1	11.60	1	10.60	1	9.84	1	9.00	400
3	2	3	.78	3	0.10	2	14.60	2	13.40	2	11.40	2	9.66	2	8	2	6.46	2	5.46	2	3.71	2	2.49	2	1.33	2	0.01	1	15.20	500
3	12	3	10.05	3	9.71	3	7.95	3	6.54	3	4.15	3	2.00	3	....	2	14.10	2	12 80	2	10.80	2	9.39	2	8.00	2	6.76	2	5.50	600
4	6	4	4.24	4	3.33	4	1.27	3	15.60	3	12.80	3	10.30	3	8	3	5.84	3	3.37	3	2.00	3	0.29	2	14.60	2	13.20	2	11.70	700
5	....	4	14.10	4	12.90	4	10.60	4	8.72	4	5.53	4	2.66	4	....	3	13.50	3	11.80	3	9.14	3	7.19	3	5.33	3	3.69	3	2.00	800
5	10	5	7 80	5	6.57	5	3.92	5	1.81	4	14.20	4	11.00	4	8	4	5.23	4	3.33	4	0.28	3	14.10	3	12.00	3	10.10	3	8.25	900
6	4	6	1.56	6	0.20	5	13.20	5	10.90	5	6.93	5	3.33	5	....	4	12.90	4	10.80	4	7.43	4	4.99	4	2.66	4	0.61	3	14.50	1000
12	8	12	3.12	12	0.5	11	10.50	11	5.82	10	13.90	10	6.60	10	....	9	9.84	9	5.62	8	14.80	8	9.99	8	5.33	8	1.22	7	13.00	2000
18	12	18	6.68	13	0.52	17	7.75	17	0.73	16	4.88	15	10.00	15	....	14	6.76	13	15.40	13	6.28	12	14.90	12	8	12	1.83	11	11.50	3000
25	....	24	6.24	24	0.76	23	5.00	22	11.60	21	11.80	20	13.30	20	....	19	3.69	18	11.20	17	13.70	17	3.98	16	10.60	16	2.45	15	10.00	4000
31	4	30	7.85	30	[illegible]	29	2.25	28	6.55	27	2.81	26	0.66	25	....	24	0.61	23	6.07	22	5.14	21	8.98	20	13.30	20	3.06	19	8.50	5000
37	8	36	9.36	35	1.16	34	15.50	34	1.46	33	3.76	31	4.00	30	....	28	13.50	28	0.88	26	12.50	25	13.90	25	....	34	3.67	23	7.00	6000
42	12	42	10.90	42	1.37	40	2.75	39	12.30	38	0.72	36	7.33	35	....	33	10.40	32	11.70	31	4 00	30	2.97	29	2.66	28	4.29	27	5.50	7000
50	....	48	12.40	48	1.95	46	10.00	45	7.28	43	7.60	41	10.60	40	....	38	7.38	37	6.52	35	11.40	34	7.95	33	5.33	32	4.90	31	4.00	8000
56	4	54	14.00	54	1.71	52	7.25	51	2.19	48	14.40	46	14.00	45	....	43	4.30	41	7.33	40	2.85	38	12.90	37	8	36	5.51	35	2.50	9000
62	8	60	15.60	59	1.95	58	4.50	56	13.10	54	5.60	52	13.30	50	....	48	12.30	46	12.10	44	10.20	43	1.93	41	10.6	40	6.13	39	1.00	10.000

TABLE SHOWING THE WEIGHT OF FILLING PER YARD OF CLOTH, IN OUNCES, WITH NO. 1 RUN YARN.

Picks pr in.	60 In. in r'd	61 In. in Reed	62 In. in Reed	63 In. in Reed	64 In. in Reed	65 In. in Reed	66 In. in Reed	67 In. in Reed	68 In. in Reed	69 In. in Reed	70 In. in Reed	72 In. in Reed	74 In. in Reed	76 In. in Reed	78 In. in Reed	80 In. in r'd	82 In. in Reed	85 In. in Reed	87 In. in Reed	90 In. in R'd.
20	12	12.2	12.4	12.6	12.8	13	13.2	13.4	13.6	13.8	14	14.4	14.8	15.2	15.6	16	16.4	17	17.4	18
25	15	15.25	15.5	15.75	16	16.25	16.50	16.75	17	17.25	17.5	18	18.5	19	19.5	20	20.5	21.25	21.75	22.5
30	18	18.3	18.6	18.9	19.2	19.5	19.8	20.1	20.4	20.7	21	21.6	22.2	22.8	23.4	24	24.6	25.5	26.1	27
35	21	21.35	21.7	22.5	22.4	22.75	23.1	23.45	23.8	24.15	24.5	25.2	25.9	26.6	27.3	28	28.7	29.75	30.45	31.5
40	24	24.4	24.8	25.2	25.6	26	26.4	26.8	27.2	27.6	28	28.8	29.6	30.4	31.2	32	32.8	34	34.8	36
45	27	27.45	27.9	28.25	28.65	29.1	29.55	30	30.45	30.9	31.5	32.4	33.3	34.2	35.1	36	36.9	38.25	39.15	40.5
50	30	30.5	31	31.50	32	32.5	33	33.5	34	34.5	35	36	37	38	39	40	41	42.5	43.5	45
55	33	33.55	34.1	34.65	35.20	35.75	36.3	36.85	37.4	37.95	38.5	39.6	40.7	41.8	42.9	44	45.1	46.75	47.85	49.5
60	36	36.6	37.2	37.8	38.4	39	39.6	40.2	40.8	41.4	42	43.2	44.4	45.6	46.8	48	49.2	51	52.2	54
65	39	39.65	40.3	40.95	41.6	42.25	42.85	43.5	44.15	44.8	45.5	46.8	48.1	49.4	50.7	52	53.3	55.25	56.55	58.5
70	42	42.7	43.4	44.10	44.8	45.5	46.2	46.9	47.6	48.3	49	50.4	51.8	53.2	54.6	56	57.4	59.5	60.9	63
75	45	45.75	46.5	47.25	48	48.75	49.5	50.25	51	51.75	52.5	54	55.5	57	58.5	60	61.5	63.75	65.25	67.5
80	48	48.8	49.6	50.4	51.2	52	52.8	53.6	54.4	55.2	56	57.6	59.2	60.8	62.4	64	65.6	68	69.6	72
85	51	51.85	52.7	53.55	54.4	55.25	56.1	56.95	57.8	58.65	59.5	61.2	62.9	64.6	66.3	68	69.7	72.25	73.95	76.5
90	54	54.9	55.8	56.7	57.6	58.5	59.4	60.3	61.2	62.1	63	64.8	66.6	68.4	70.2	72	73.8	76.5	78.3	81
95	57	57.95	58.9	59.85	60.8	61.75	62.7	63.65	64.6	65.55	66.5	68.4	70.3	72.2	74.1	76	77.9	80.75	82.65	85.5
100	50	61	62	63	64	65	66	67	68	69	70	72	74	76	78	80	82	85	87	90
105	63	64.5	65.1	66.15	67.2	68.25	69.3	70.35	71.4	72.45	73.5	75.6	77.7	79.8	81.9	84	86.1	89.25	91.35	94.5
110	66	67.1	68.2	69.3	70.4	71.50	72.6	73.7	74.8	75.9	77	79.2	81.4	83.6	85.8	88	90.2	93.5	95.7	99
115	69	70.15	71.3	72.45	73.6	74.75	75.9	77.05	78.2	79.35	80.5	82.8	85.1	87.4	89.7	92	94.3	97.75	100.05	103.5
120	72	73.2	74.4	75.6	76.8	78	79.2	80.4	81.6	82.8	84	86.4	88.8	91.2	93.6	96	98.4	102	104.4	108
125	75	76.25	77.5	78.75	80	81.25	82.50	83.75	85	86.25	87.5	90	92.5	95	97.5	100	102.5	106.25	108.75	112.5
130	78	79.3	80.6	81.9	83.2	84.5	85.8	87.1	87.4	88.7	91	93.6	96.2	98.8	101.4	104	106.6	110.5	113.1	117
135	81	82.35	83.7	85.5	86.4	87.75	89.1	90.45	91.75	93.1	94.5	97.2	99.9	102.6	105.3	108	110.7	114.75	117.45	121.5
140	84	85.4	86.8	88.20	89.6	91	92.4	93.8	95.2	96.6	98	100.8	103.6	106.4	109.2	112	114.8	119	121.8	126
145	87	88.45	89.9	91.35	92.8	94.25	95.7	97.15	98.60	100.05	101.5	104.4	107.3	110.2	113.1	116	118.9	123.25	126.15	130.5
150	90	91.5	03	94.5	96	97.5	99	100.5	102	103.5	105	108	111	114	117	120	123	127.5	130.5	135
155	93	94.55	96.10	97.65	99.2	100.75	102.2	103.75	105.3	106.85	108.5	111.6	114.7	117.8	120.9	124	127	131.75	134.85	139.5
160	96	97.6	99.2	100.8	102.4	104	105.6	107.2	108.8	110.4	112	115.2	118.4	121.6	124.8	128	131.2	136	139.2	144
165	99	100.65	102.3	103.95	105.6	107.25	108.9	110.55	112.2	113.9	115.5	118.8	122.1	125.4	128.7	132	135.3	140.25	143.55	148.5
170	102	103.7	105.4	107.10	108.8	110.50	112.2	113.9	115.6	117.3	119	122.4	125.8	129.2	132.6	136	139.4	144.5	147.9	153
175	105	106.75	108.5	110.25	112	113.75	115.5	117.25	119	120.75	122.5	126	129.5	133	136.5	140	143.5	148.75	152.25	157.5

Table of Warp or Filling Yarn Required for One Yard of Cloth with No. 1 Yarn, in Yards, Hanks, Pounds and Ounces.—For Worsted Yarn.

Th'ds per Inch.	Width of Goods, 27 Inches.				Width of Goods, 28 Inches.				Width of Goods, 29 Inches.				Width of Goods, 30 Inches.			
	Yards.	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.
20	540	$\frac{27}{28}$		$15\frac{3}{7}$	560	1	1		580	$1\frac{1}{28}$	1	$\frac{4}{7}$	600	$1\frac{1}{14}$	1	$1\frac{1}{7}$
24	648	$1\frac{11}{70}$	1	$2\frac{18}{35}$	672	$1\frac{1}{5}$	1	$3\frac{1}{5}$	696	$1\frac{17}{70}$	1	$3\frac{33}{35}$	720	$1\frac{2}{7}$	1	$4\frac{4}{7}$
25	675	$1\frac{23}{112}$	1	$3\frac{2}{7}$	700	$1\frac{1}{4}$	1	4	725	$1\frac{33}{112}$	1	$4\frac{5}{7}$	750	$1\frac{19}{56}$	1	$5\frac{3}{7}$
28	756	$1\frac{7}{20}$	1	$5\frac{3}{5}$	784	$1\frac{2}{5}$	1	$6\frac{2}{5}$	812	$1\frac{9}{20}$	1	$7\frac{1}{5}$	840	$1\frac{1}{2}$	1	8
30	810	$1\frac{25}{56}$	1	$7\frac{1}{7}$	840	$1\frac{1}{2}$	1	8	870	$1\frac{31}{56}$	1	$9\frac{1}{28}$	900	$1\frac{17}{28}$	1	$9\frac{5}{7}$
32	864	$1\frac{19}{35}$	1	$8\frac{24}{35}$	896	$1\frac{3}{5}$	1	$9\frac{3}{5}$	928	$1\frac{23}{35}$	1	$10\frac{18}{35}$	960	$1\frac{5}{7}$	1	$17\frac{3}{7}$
35	945	$1\frac{11}{16}$	1	11	980	$1\frac{3}{4}$	1	12	1015	$1\frac{91}{112}$	1	13	1050	$1\frac{7}{8}$	1	14
36	972	$1\frac{103}{140}$	1	$11\frac{27}{35}$	1008	$1\frac{4}{5}$	1	$12\frac{4}{5}$	1044	$1\frac{121}{140}$	1	$13\frac{29}{35}$	1080	$1\frac{13}{14}$	1	$14\frac{6}{7}$
40	1080	$1\frac{13}{14}$	1	$14\frac{6}{7}$	1120	2	2		1160	$2\frac{1}{14}$	2	$1\frac{1}{7}$	1200	$2\frac{1}{7}$	2	$2\frac{2}{7}$
44	1188	$2\frac{17}{140}$	2	$1\frac{33}{35}$	1232	$2\frac{1}{5}$	2	$3\frac{1}{5}$	1276	$2\frac{39}{140}$	2	$4\frac{16}{35}$	1320	$2\frac{5}{14}$	2	$5\frac{5}{7}$
45	1215	$2\frac{19}{112}$	2	$2\frac{6}{35}$	1260	$2\frac{1}{4}$	2	4	1305	$2\frac{37}{112}$	2	$5\frac{2}{7}$	1350	$2\frac{23}{56}$	2	$6\frac{4}{7}$
48	1296	$2\frac{11}{35}$	2	$5\frac{1}{35}$	1344	$2\frac{2}{5}$	2	$6\frac{2}{5}$	1392	$2\frac{17}{35}$	2	$7\frac{27}{35}$	1440	$2\frac{4}{7}$	2	$9\frac{1}{7}$
50	1350	$2\frac{23}{56}$	2	$6\frac{4}{7}$	1400	$2\frac{19}{28}$	2	$10\frac{6}{7}$	1450	$2\frac{33}{56}$	2	$9\frac{3}{7}$	1500	$2\frac{19}{28}$	2	$10\frac{6}{7}$
55	1485	$2\frac{73}{112}$	2	$10\frac{3}{7}$	1540	$2\frac{3}{4}$	2	12	1595	$2\frac{95}{112}$	2	$13\frac{4}{7}$	1650	$2\frac{53}{56}$	2	$15\frac{1}{7}$
60	1620	$2\frac{25}{28}$	2	$14\frac{2}{7}$	1680	3	3		1740	$3\frac{3}{28}$	3	$1\frac{5}{7}$	1800	$3\frac{3}{14}$	3	$3\frac{3}{7}$
65	1755	$3\frac{15}{112}$	3	$2\frac{1}{7}$	1820	$3\frac{1}{4}$	3	4	1885	$3\frac{41}{112}$	3	$5\frac{6}{7}$	1950	$3\frac{27}{56}$	3	$7\frac{5}{7}$
70	1890	$3\frac{3}{8}$	3	6	1960	$3\frac{1}{2}$	3	8	2030	$3\frac{5}{8}$	3	10	2100	$3\frac{3}{4}$	3	12
75	2025	$3\frac{69}{112}$	3	$9\frac{6}{7}$	2100	$3\frac{3}{4}$	3	12	2175	$3\frac{99}{112}$	3	$14\frac{1}{7}$	2250	$4\frac{1}{56}$	4	$\frac{2}{7}$
80	2160	$3\frac{6}{7}$	3	$13\frac{5}{7}$	2240	4	4		2320	$4\frac{1}{7}$	4	$2\frac{2}{7}$	2400	$4\frac{2}{7}$	4	$4\frac{4}{7}$
85	2295	$4\frac{11}{112}$	4	$1\frac{4}{7}$	2380	$4\frac{1}{4}$	4	4	2465	$4\frac{45}{112}$	4	$6\frac{3}{7}$	2550	$4\frac{31}{56}$	4	$8\frac{6}{7}$
90	2430	$4\frac{19}{56}$	4	$5\frac{3}{7}$	2520	$4\frac{1}{2}$	4	8	2610	$4\frac{37}{56}$	4	$10\frac{4}{7}$	2700	$4\frac{23}{28}$	4	$13\frac{1}{7}$
95	2565	$4\frac{65}{112}$	4	$9\frac{2}{7}$	2660	$4\frac{3}{4}$	4	12	2755	$4\frac{103}{112}$	4	$14\frac{5}{7}$	2850	$5\frac{5}{56}$	5	$1\frac{3}{7}$
100	2700	$4\frac{23}{28}$	4	$13\frac{1}{7}$	2800	5	5		2900	$5\frac{5}{28}$	5	$2\frac{6}{7}$	3000	$5\frac{5}{14}$	5	$5\frac{5}{7}$
105	2835	$5\frac{1}{16}$	5	1	2940	$5\frac{1}{4}$	5	4	3045	$5\frac{7}{16}$	5	7	3150	$5\frac{35}{56}$	5	10
110	2970	$5\frac{17}{56}$	5	$4\frac{6}{7}$	3080	$5\frac{1}{2}$	5	8	3190	$5\frac{39}{56}$	5	$11\frac{1}{7}$	3300	$5\frac{25}{28}$	5	$14\frac{2}{7}$
115	3105	$5\frac{61}{112}$	5	$8\frac{5}{7}$	3220	$5\frac{3}{4}$	5	12	3335	$5\frac{107}{112}$	5	$15\frac{2}{7}$	3450	$6\frac{9}{56}$	6	$2\frac{4}{7}$
120	3240	$5\frac{11}{14}$	5	$12\frac{4}{7}$	3360	6	6		3480	$6\frac{3}{14}$	6	$3\frac{3}{7}$	3600	$6\frac{3}{7}$	6	$6\frac{6}{7}$
125	3375	$6\frac{3}{112}$	6	$\frac{3}{7}$	3500	$6\frac{1}{4}$	6	4	3625	$6\frac{53}{112}$	6	$7\frac{4}{7}$	3750	$6\frac{39}{56}$	6	$11\frac{1}{7}$
130	3510	$6\frac{15}{56}$	6	$4\frac{2}{7}$	3640	$6\frac{1}{2}$	6	8	3770	$6\frac{41}{56}$	6	$11\frac{5}{7}$	3900	$6\frac{27}{28}$	6	$15\frac{3}{7}$
135	3645	$6\frac{57}{112}$	6	$8\frac{1}{7}$	3780	$6\frac{3}{4}$	6	12	3915	$6\frac{111}{112}$	6	$15\frac{6}{7}$	4050	$7\frac{13}{56}$	7	$3\frac{5}{7}$
140	3780	$6\frac{3}{4}$	6	12	3920	7	7		4060	$7\frac{1}{4}$	7	4	4200	$7\frac{1}{2}$	7	8
145	3915	$6\frac{111}{112}$	6	$15\frac{6}{7}$	4060	$7\frac{1}{4}$	7	4	4205	$7\frac{57}{112}$	7	$8\frac{1}{7}$	4350	$7\frac{43}{56}$	7	$12\frac{2}{7}$
150	4050	$7\frac{13}{56}$	7	$3\frac{5}{7}$	4200	$7\frac{1}{2}$	7	8	4350	$7\frac{43}{56}$	7	$12\frac{2}{7}$	4500	$8\frac{1}{28}$	8	$\frac{4}{7}$

Table of Warp or Filling Yarn Required for One Yard of Cloth with No. 1 Yarn, Single, in Yards, Hanks, Pounds and Ounces.—For Worsted Yarn.

Th'ds per Inch.	Width of Goods, 31 Inches.				Width of Goods, 32 Inches.				Width of Goods, 33 Inches.				Width of Goods, 34 Inches.			
	Yards.	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.	Yards	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.
20	620	1 3/28	1	1 5/7	640	1 1/7	1	2 2/7	660	1 5/28	1	2 6/7	680	1 3/14	1	3 3/7
24	744	1 23/70	1	5 9/35	768	1 13/35	1	5 33/35	792	1 29/70	1	6 22/35	816	1 16/35	1	7 11/35
25	775	1 43/112	1	6 1/7	800	1 3/7	1	6 6/7	825	1 53/112	1	7 4/7	850	1 29/56	1	8 2/7
28	868	1 11/20	1	8 4/5	896	1 3/5	1	9 3/5	924	1 81/140	1	9 9/35	952	1 7/10	1	10 1/5
30	930	1 37/56	1	10 4/7	960	1 5/7	1	11 3/7	990	1 43/56	1	12 2/7	1020	1 23/28	1	13 1/7
32	992	1 27/35	1	12 12/35	1024	1 53/70	1	12 4/35	1056	1 31/35	1	14 6/35	1088	1 33/35	1	15 3/35
35	1085	1 105/112	1	15	1120	2	2		1155	2 1/16	2	1	1190	2 1/8	2	2
36	1116	1 139/140	1	15 31/35	1152	2 2/35	2	32/35	1188	2 17/140	2	1 33/35	1224	2 13/70	2	2 34/35
40	1240	2 3/14	2	3 3/7	1280	2 2/7	2	4 4/7	1320	2 5/14	2	5 5/7	1360	2 3/7	2	6 6/7
44	1364	2 61/140	2	6 34/35	1408	2 18/35	2	8 8/35	1452	2 83/140	2	9 17/35	1496	2 93/140	2	10 22/35
45	1395	2 55/112	2	7 6/7	1440	2 4/7	2	9 1/7	1485	2 75/112	2	10 5/7	1530	2 3/4	2	12
48	1488	2 23/35	2	10 18/35	1536	2 26/35	2	11 31/35	1584	2 29/35	2	13 9/35	1632	2 32/35	2	14 22/35
50	1550	2 43/56	2	12 2/7	1600	2 6/7	2	13 5/7	1650	2 53/56	2	15 1/7	1700	3 1/28	3	4/7
55	1705	3 5/112	3	5/7	1760	3 1/7	3	2 2/7	1815	3 27/112	3	3 6/7	1870	3 19/56	3	5 3/7
60	1860	3 9/28	3	5 1/7	1920	3 3/7	3	6 6/7	1980	3 15/28	3	8 4/7	2040	3 9/14	3	10 2/7
65	2015	3 67/112	3	9 4/7	2080	3 5/7	3	11 3/7	2145	3 93/112	3	13 2/7	2210	3 53/56	3	15 1/7
70	2170	3 7/8	3	14	2240	4	4		2310	4 1/8	4	2	2380	4 1/4	4	4
75	2325	4 17/112	4	2 3/7	2400	4 2/7	4	4 4/7	2475	4 47/112	4	6 5/7	2550	4 31/56	4	8 6/7
80	2480	4 3/7	4	6 6/7	2560	4 4/7	4	9 1/7	2640	4 5/7	4	11 3/7	2720	4 6/7	4	13 5/7
85	2635	4 79/112	4	11 2/7	2720	4 6/7	4	13 5/7	2805	5 1/112	5	1/7	2890	5 9/56	5	2 4/7
90	2790	4 55/56	4	15 5/7	2880	5 1/7	5	2 2/7	2970	5 17/56	5	4 6/7	3060	5 13/28	5	7 3/7
95	2945	5 29/112	5	4 1/7	3040	5 3/7	5	6 6/7	3135	5 67/112	5	9 4/7	3230	5 43/56	5	12 2/7
100	3100	5 15/28	5	8 4/7	3200	5 5/7	5	11 3/7	3300	5 25/28	5	14 2/7	3400	6 1/14	6	1 1/7
105	3255	5 91/112	5	13	3360	6	6		3465	6 3/16	6	3	3570	6 3/8	6	6
110	3410	6 5/56	6	1 3/7	3520	6 2/7	6	4 4/7	3630	6 27/56	6	7 5/7	3740	6 19/28	6	10 6/7
115	3565	6 41/112	6	5 6/7	3680	6 4/7	6	9 1/7	3795	6 87/112	6	12 3/7	3910	6 55/56	6	15 5/7
120	3720	6 9/14	6	10 2/7	3840	6 6/7	6	13 5/7	3960	7 1/14	7	1 1/7	4080	7 2/7	7	4 4/7
125	3875	6 103/112	6	14 5/7	4000	7 1/7	7	2 2/7	4125	7 41/112	7	5 6/7	4250	7 33/56	7	9 3/7
130	4030	7 11/56	7	3 1/7	4160	7 3/7	7	6 6/7	4290	7 37/56	7	10 4/7	4420	7 25/28	7	14 2/7
135	4185	7 53/112	7	7 4/7	4320	7 5/7	7	11 3/7	4455	7 107/112	7	15 2/7	4590	8 11/56	8	3 1/7
140	4340	7 3/4	7	12	4480	8	8		4620	8 1/4	8	4	4760	8 1/2	8	8
145	4495	8 3/112	8	3/7	4640	8 2/7	8	4 4/7	4785	8 61/112	8	8 5/7	4930	8 45/56	8	12 6/7
150	4650	8 17/56	8	4 6/7	4800	8 4/7	8	9 1/7	4950	8 47/56	8	13 3/7	5100	9 3/28	8	1 5/7

Table of Warp or Filling Yarn Required for One Yard of Cloth with No. 1 Yarn, Single, in Yards, Hanks, Pounds and Ounces.—For Worsted Yarn.

Th'ds per Inch.	Width of Goods, 35 Inches.				Width of Goods, 36 Inches.				Width of Goods, 37 Inches.				Width of Goods, 38 Inches.			
	Yards.	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.
20	700	$1\frac{1}{4}$	1	4	720	$1\frac{2}{7}$	1	$4\frac{4}{7}$	740	$1\frac{9}{28}$	1	$5\frac{1}{7}$	760	$1\frac{5}{14}$	1	$5\frac{5}{7}$
24	840	$1\frac{1}{2}$	1	8	864	$1\frac{19}{35}$	1	$8\frac{24}{35}$	888	$1\frac{41}{70}$	1	$9\frac{13}{35}$	912	$1\frac{22}{35}$	1	$10\frac{2}{35}$
25	875	$1\frac{9}{16}$	1	9	900	$1\frac{17}{28}$	1	$9\frac{5}{7}$	925	$1\frac{73}{112}$	1	$10\frac{3}{7}$	950	$1\frac{39}{56}$	1	$11\frac{3}{28}$
28	980	$1\frac{3}{4}$	1	12	1008	$1\frac{4}{5}$	1	$12\frac{4}{5}$	1036	$1\frac{17}{20}$	1	$13\frac{3}{4}$	1064	$1\frac{9}{10}$	1	$14\frac{2}{5}$
30	1050	$1\frac{7}{8}$	1	14	1080	$1\frac{13}{14}$	1	$14\frac{6}{7}$	1110	$1\frac{55}{56}$	1	$15\frac{5}{7}$	1140	$2\frac{1}{28}$	2	$\frac{4}{7}$
32	1120	2	2		1152	$2\frac{2}{35}$	2	$\frac{32}{35}$	1184	$2\frac{4}{35}$	2	$1\frac{29}{35}$	1216	$2\frac{6}{35}$	2	$2\frac{26}{35}$
35	1225	$2\frac{3}{16}$	2	3	1260	$2\frac{1}{4}$	2	4	1295	$2\frac{5}{16}$	2	5	1330	$2\frac{3}{8}$	2	6
36	1260	$2\frac{1}{4}$	2	4	1296	$2\frac{11}{35}$	2	$5\frac{1}{35}$	1332	$2\frac{53}{146}$	2	$6\frac{2}{35}$	1368	$2\frac{31}{70}$	2	$7\frac{3}{35}$
40	1400	$2\frac{1}{2}$	2	8	1440	$2\frac{4}{7}$	2	$9\frac{1}{7}$	1480	$2\frac{9}{14}$	2	$10\frac{2}{7}$	1520	$2\frac{5}{7}$	2	$11\frac{3}{7}$
44	1540	$2\frac{3}{4}$	2	12	1584	$2\frac{29}{35}$	2	$13\frac{9}{35}$	1628	$2\frac{127}{140}$	2	$14\frac{37}{70}$	1672	$2\frac{69}{70}$	2	$15\frac{27}{35}$
45	1575	$2\frac{13}{16}$	2	13	1620	$2\frac{25}{28}$	2	$14\frac{2}{7}$	1665	$2\frac{109}{112}$	2	$15\frac{4}{7}$	1710	$3\frac{3}{56}$	3	$\frac{6}{7}$
48	1680	3	3		1728	$3\frac{3}{35}$	3	$1\frac{13}{35}$	1776	$3\frac{6}{35}$	3	$2\frac{26}{35}$	1824	$3\frac{9}{35}$	3	$4\frac{4}{35}$
50	1750	$3\frac{1}{8}$	3	2	1800	$3\frac{3}{14}$	3	$3\frac{3}{7}$	1850	$3\frac{17}{56}$	3	$4\frac{6}{7}$	1900	$3\frac{11}{28}$	3	$6\frac{2}{7}$
55	1925	$3\frac{7}{16}$	3	7	1980	$3\frac{15}{28}$	3	$8\frac{4}{7}$	2035	$3\frac{71}{112}$	3	$10\frac{1}{7}$	2090	$3\frac{41}{56}$	3	$11\frac{5}{7}$
60	2100	$3\frac{3}{4}$	3	12	2160	$3\frac{6}{7}$	3	$13\frac{5}{7}$	2220	$3\frac{27}{28}$	3	$15\frac{3}{7}$	2280	$4\frac{1}{14}$	4	$1\frac{1}{7}$
65	2275	4	4	1	2340	$4\frac{5}{28}$	4	$2\frac{6}{7}$	2405	$4\frac{33}{112}$	4	$4\frac{5}{7}$	2470	$4\frac{23}{56}$	4	$6\frac{4}{7}$
70	2450	$4\frac{3}{8}$	4	6	2520	$4\frac{1}{2}$	4	8	2590	$4\frac{5}{8}$	4	10	2660	$4\frac{3}{4}$	4	12
75	2625	$4\frac{11}{16}$	4	11	2700	$4\frac{23}{28}$	4	$13\frac{1}{7}$	2775	$4\frac{107}{112}$	4	$15\frac{2}{7}$	2850	$5\frac{5}{56}$	5	$1\frac{3}{7}$
80	2800	5	5		2880	$5\frac{1}{7}$	5	$2\frac{2}{7}$	2960	$5\frac{2}{7}$	5	$4\frac{4}{7}$	3040	$5\frac{3}{7}$	5	$6\frac{6}{7}$
85	2975	$5\frac{5}{16}$	5	5	3060	$5\frac{13}{28}$	5	$7\frac{3}{7}$	3145	$5\frac{69}{112}$	5	$9\frac{6}{7}$	3220	$5\frac{13}{56}$	5	$12\frac{2}{7}$
90	3150	$5\frac{5}{8}$	5	10	3240	$5\frac{11}{14}$	5	$12\frac{4}{7}$	3330	$5\frac{53}{56}$	5	$15\frac{1}{7}$	3420	$6\frac{3}{28}$	6	$1\frac{5}{7}$
95	3325	$6\frac{15}{16}$	5	15	3420	$6\frac{3}{28}$	6	$1\frac{5}{7}$	3515	$6\frac{31}{112}$	6	$4\frac{3}{7}$	3610	$6\frac{25}{56}$	6	$7\frac{1}{7}$
100	3500	$6\frac{1}{4}$	6	4	3600	$6\frac{3}{7}$	6	$6\frac{6}{7}$	3700	$6\frac{17}{28}$	6	$9\frac{5}{7}$	3800	$6\frac{11}{14}$	6	$12\frac{4}{7}$
105	3675	$6\frac{9}{16}$	6	9	3780	$6\frac{3}{4}$	6	12	3885	$6\frac{105}{112}$	6	15	3990	$7\frac{1}{8}$	7	2
110	3850	$6\frac{7}{8}$	6	14	3960	$7\frac{1}{14}$	7	$1\frac{1}{7}$	4070	$7\frac{15}{56}$	7	$4\frac{2}{7}$	4180	$7\frac{13}{28}$	7	$7\frac{3}{7}$
115	4025	$7\frac{3}{16}$	7	3	4140	$7\frac{11}{28}$	7	$6\frac{2}{7}$	4255	$7\frac{67}{112}$	7	$9\frac{4}{7}$	4370	$7\frac{45}{56}$	7	$12\frac{6}{7}$
120	4200	$7\frac{1}{2}$	7	8	4320	$7\frac{5}{7}$	7	$11\frac{3}{7}$	4440	$7\frac{13}{14}$	7	$14\frac{6}{7}$	4560	$8\frac{1}{7}$	8	$2\frac{2}{7}$
125	4375	$7\frac{13}{16}$	7	13	4500	$8\frac{1}{28}$	8	$\frac{4}{7}$	4625	$8\frac{29}{112}$	8	$4\frac{1}{7}$	4750	$8\frac{21}{56}$	8	$7\frac{5}{7}$
130	4550	$8\frac{1}{8}$	8	2	4680	$8\frac{5}{14}$	8	$5\frac{5}{7}$	4810	$8\frac{33}{56}$	8	$9\frac{3}{7}$	4940	$8\frac{23}{28}$	8	$13\frac{1}{7}$
135	4725	$8\frac{7}{16}$	8	7	4860	$8\frac{19}{28}$	8	$10\frac{6}{7}$	4995	$8\frac{103}{112}$	8	$14\frac{5}{7}$	5130	$9\frac{9}{56}$	9	$2\frac{4}{7}$
140	4900	$8\frac{3}{4}$	8	12	5040	9	9		5180	$9\frac{1}{4}$	9	4	5320	$9\frac{1}{2}$	9	8
145	5075	$9\frac{1}{16}$	9	1	5220	$9\frac{9}{28}$	9	$5\frac{1}{7}$	5365	$9\frac{65}{112}$	9	$9\frac{2}{7}$	5510	$9\frac{47}{56}$	9	13
150	5250	$9\frac{3}{8}$	9	6	5400	$9\frac{9}{14}$	9	$10\frac{2}{7}$	5550	$9\frac{51}{56}$	9	$14\frac{4}{7}$	5700	$10\frac{5}{28}$	10	$2\frac{6}{7}$

Table of Warp or Filling Yarn Required for One Yard of Cloth with No. 1 Yarn, Single, in Yards, Hanks, Pounds and Ounces.—For Worsted Yarn.

Th'ds per Inch.	Width of Goods, 39 Inches.				Width of Goods, 40 Inches.				Width of Goods, 41 Inches.				Width of Goods, 42 Inches.			
	Yards.	Hanks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.	Yards.	Hanks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.
20	780	$1\frac{11}{28}$	1	$6\frac{2}{7}$	800	$1\frac{3}{7}$	1	$6\frac{6}{7}$	820	$1\frac{13}{28}$	1	$7\frac{3}{7}$	840	$1\frac{1}{2}$	1	8
24	936	$1\frac{47}{70}$	1	$11\frac{26}{35}$	960	$1\frac{5}{7}$	1	$11\frac{3}{7}$	984	$1\frac{53}{70}$	1	$12\frac{4}{35}$	1008	$1\frac{4}{5}$	1	$12\frac{4}{5}$
25	975	$1\frac{83}{112}$	1	$11\frac{6}{7}$	1000	$1\frac{11}{14}$	1	$12\frac{4}{7}$	1025	$1\frac{93}{112}$	1	$13\frac{2}{7}$	1050	$1\frac{7}{8}$	1	14
28	1092	$1\frac{133}{140}$	1	$15\frac{1}{5}$	1120	2	2		1148	$2\frac{1}{20}$	2	$\frac{4}{5}$	1176	$2\frac{1}{10}$	2	$1\frac{3}{5}$
30	1170	$2\frac{5}{56}$	2	$1\frac{3}{7}$	1200	$2\frac{1}{7}$	2	$2\frac{2}{7}$	1230	$2\frac{11}{56}$	2	$3\frac{1}{7}$	1260	$2\frac{1}{4}$	2	4
32	1248	$2\frac{8}{35}$	2	$3\frac{23}{35}$	1280	$2\frac{2}{7}$	2	$4\frac{4}{7}$	1312	$2\frac{12}{35}$	2	$5\frac{17}{35}$	1344	$2\frac{2}{5}$	2	$6\frac{2}{5}$
35	1365	$2\frac{49}{112}$	2	7	1400	$2\frac{1}{2}$	2	8	1435	$2\frac{9}{16}$	2	9	1470	$2\frac{5}{8}$	2	10
36	1404	$2\frac{71}{140}$	2	$8\frac{4}{35}$	1440	$2\frac{4}{7}$	2	$9\frac{1}{7}$	1476	$2\frac{89}{140}$	2	$10\frac{6}{35}$	1512	$2\frac{7}{10}$	2	$11\frac{1}{5}$
40	1560	$2\frac{11}{14}$	2	$12\frac{4}{7}$	1600	$2\frac{6}{7}$	2	$13\frac{5}{7}$	1640	$2\frac{13}{14}$	2	$14\frac{6}{7}$	1680	3	3	
44	1716	$3\frac{9}{140}$	3	$1\frac{1}{35}$	1760	$3\frac{1}{7}$	3	$2\frac{2}{7}$	1804	$3\frac{31}{140}$	3	$3\frac{19}{35}$	1848	$3\frac{3}{10}$	3	$4\frac{4}{5}$
45	1755	$3\frac{15}{112}$	3	$2\frac{1}{7}$	1800	$3\frac{3}{14}$	3	$3\frac{3}{7}$	1845	$3\frac{33}{112}$	3	$4\frac{1}{14}$	1890	$3\frac{3}{8}$	3	6
48	1872	$3\frac{19}{70}$	3	$4\frac{12}{35}$	1920	$3\frac{3}{7}$	3	$6\frac{6}{7}$	1968	$3\frac{18}{35}$	3	$8\frac{8}{35}$	2016	$3\frac{3}{5}$	3	$9\frac{3}{5}$
50	1950	$3\frac{27}{56}$	3	$7\frac{5}{7}$	2000	$3\frac{4}{7}$	3	$9\frac{1}{7}$	2050	$3\frac{37}{56}$	3	$10\frac{37}{56}$	2100	$3\frac{3}{4}$	3	12
55	2145	$3\frac{93}{112}$	3	$13\frac{2}{7}$	2200	$3\frac{13}{14}$	3	$14\frac{6}{7}$	2255	$4\frac{3}{112}$	4	$\frac{3}{7}$	2310	$4\frac{1}{8}$	4	2
60	2340	$4\frac{5}{28}$	4	$2\frac{6}{7}$	2400	$4\frac{2}{7}$	4	$4\frac{4}{7}$	2460	$4\frac{11}{28}$	4	$6\frac{2}{7}$	2520	$4\frac{1}{2}$	4	8
65	2535	$4\frac{59}{112}$	4	$8\frac{3}{7}$	2600	$4\frac{9}{14}$	4	$10\frac{2}{7}$	2665	$4\frac{85}{112}$	4	$12\frac{1}{7}$	2730	$4\frac{7}{8}$	4	14
70	2730	$4\frac{49}{56}$	4	14	2800	5	5		2870	$5\frac{1}{8}$	5	2	2940	$5\frac{1}{4}$	5	4
75	2925	$5\frac{25}{112}$	5	$3\frac{4}{7}$	3000	$5\frac{5}{14}$	5	$5\frac{5}{7}$	3075	$5\frac{55}{112}$	5	$7\frac{6}{7}$	3150	$5\frac{5}{8}$	5	10
80	3120	$5\frac{4}{7}$	5	$9\frac{1}{7}$	3200	$5\frac{5}{7}$	5	$11\frac{3}{7}$	3280	$5\frac{6}{7}$	5	$13\frac{5}{7}$	3360	6	6	
85	3315	$5\frac{103}{112}$	5	$14\frac{5}{7}$	3400	$6\frac{1}{14}$	6	$1\frac{1}{7}$	3485	$6\frac{25}{112}$	6	$3\frac{4}{7}$	3570	$6\frac{3}{8}$	6	6
90	3510	$6\frac{15}{56}$	6	$4\frac{2}{7}$	3600	$6\frac{3}{7}$	6	$6\frac{6}{7}$	3690	$6\frac{33}{56}$	6	$9\frac{3}{7}$	3780	$6\frac{3}{4}$	6	12
95	3705	$6\frac{69}{112}$	6	$9\frac{6}{7}$	3800	$6\frac{11}{14}$	6	$12\frac{4}{7}$	3895	$6\frac{107}{112}$	6	$15\frac{2}{7}$	3990	$7\frac{1}{8}$	7	2
100	3900	$6\frac{27}{28}$	6	$15\frac{1}{2}$	4000	$7\frac{1}{7}$	7	$2\frac{2}{7}$	4100	$7\frac{9}{28}$	7	$5\frac{1}{7}$	4200	$7\frac{1}{2}$	7	8
105	4095	$7\frac{5}{16}$	7	5	4200	$7\frac{1}{2}$	7	8	4305	$7\frac{77}{112}$	7	11	4410	$7\frac{7}{8}$	7	14
110	4290	$7\frac{37}{56}$	7	$10\frac{4}{7}$	4400	$7\frac{6}{7}$	7	$13\frac{5}{7}$	4510	$8\frac{3}{56}$	8	$\frac{6}{7}$	4620	$8\frac{1}{4}$	8	4
115	4485	$8\frac{1}{112}$	8	$\frac{1}{7}$	4600	$8\frac{3}{14}$	8	$3\frac{3}{7}$	4715	$8\frac{47}{112}$	8	$6\frac{5}{7}$	4830	$8\frac{5}{8}$	8	10
120	4680	$8\frac{5}{14}$	8	$5\frac{5}{7}$	4800	$8\frac{4}{7}$	8	$9\frac{1}{7}$	4920	$8\frac{11}{14}$	8	$12\frac{4}{7}$	5040	9	9	
125	4875	$8\frac{79}{112}$	8	$11\frac{2}{7}$	5000	$8\frac{13}{14}$	8	$14\frac{6}{7}$	5125	$9\frac{17}{112}$	9	$2\frac{3}{7}$	5250	$9\frac{3}{8}$	9	6
130	5070	$9\frac{3}{56}$	9	$\frac{6}{7}$	5200	$9\frac{2}{7}$	9	$4\frac{4}{7}$	5330	$9\frac{29}{56}$	9	$8\frac{2}{7}$	5460	$9\frac{3}{4}$	9	12
135	5265	$9\frac{45}{112}$	9	$6\frac{3}{7}$	5400	$9\frac{9}{14}$	9	$10\frac{2}{7}$	5535	$9\frac{99}{112}$	9	$14\frac{1}{7}$	5670	$10\frac{1}{8}$	10	2
140	5460	$9\frac{3}{4}$	9	12	5600	10	10		5740	$10\frac{1}{4}$	10	4	5880	$10\frac{1}{2}$	10	8
145	5655	$10\frac{11}{112}$	10	$1\frac{4}{7}$	5800	$10\frac{5}{14}$	10	$5\frac{5}{7}$	5945	$10\frac{69}{112}$	10	$9\frac{6}{7}$	6090	$10\frac{7}{8}$	10	14
150	5850	$10\frac{25}{56}$	10	$7\frac{1}{7}$	6000	$10\frac{5}{7}$	10	$11\frac{3}{7}$	6150	$10\frac{55}{56}$	10	$15\frac{5}{7}$	6300	$11\frac{1}{4}$	11	4

Table of Warp or Filling Yarn Required for One Yard Square of Cloth with No. 1 Yarn, in Yards, Hanks, Pounds and Ounces.—For Cotton Yarn.

Th'ds per Inch.	Width of Goods, 27 Inches.				Width of Goods, 28 Inches.				Width of Goods, 29 Inches.				Width of Goods, 30 Inches.			
	Yards.	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.
20	540	$\frac{9}{14}$		$10\frac{2}{7}$	560	$\frac{2}{3}$		$10\frac{2}{3}$	580	$\frac{29}{42}$		$11\frac{2}{21}$	600	$\frac{5}{7}$		$11\frac{3}{7}$
24	648	$\frac{27}{35}$		$12\frac{12}{35}$	672	$\frac{4}{5}$		$12\frac{4}{5}$	696	$\frac{29}{35}$		$13\frac{9}{35}$	720	$\frac{6}{7}$		$13\frac{5}{7}$
25	675	$\frac{45}{56}$		$12\frac{6}{7}$	700	$\frac{5}{6}$		$13\frac{1}{3}$	725	$\frac{145}{168}$		$13\frac{17}{21}$	750	$\frac{25}{28}$		$14\frac{2}{7}$
28	756	$\frac{9}{10}$		$14\frac{2}{5}$	784	$\frac{14}{15}$		$14\frac{14}{15}$	812	$\frac{29}{30}$		$15\frac{7}{15}$	840	1	1	
30	810	$\frac{27}{28}$		$15\frac{3}{7}$	840	1	1		870	$1\frac{1}{28}$	1	$\frac{4}{7}$	900	$1\frac{1}{14}$	1	$1\frac{2}{7}$
32	864	$1\frac{1}{35}$	1	$\frac{16}{35}$	896	$1\frac{1}{15}$	1	$1\frac{1}{15}$	928	$1\frac{11}{105}$	1	$1\frac{71}{105}$	960	$1\frac{1}{7}$	1	$2\frac{2}{7}$
35	945	$1\frac{1}{8}$	1	2	980	$1\frac{1}{6}$	1	$2\frac{2}{3}$	1015	$1\frac{5}{24}$	1	$3\frac{1}{3}$	1050	$1\frac{1}{4}$	1	4
36	972	$1\frac{11}{70}$	1	$2\frac{36}{70}$	1008	$1\frac{1}{5}$	1	$3\frac{1}{5}$	1044	$1\frac{17}{70}$	1	$3\frac{31}{35}$	1080	$1\frac{2}{7}$	1	$4\frac{4}{7}$
40	1080	$1\frac{2}{7}$	1	$4\frac{4}{7}$	1120	$1\frac{1}{3}$	1	$5\frac{1}{3}$	1160	$1\frac{8}{21}$	1	$6\frac{2}{21}$	1200	$1\frac{3}{7}$	1	$6\frac{6}{7}$
44	1188	$1\frac{29}{70}$	1	$6\frac{22}{35}$	1232	$1\frac{7}{15}$	1	$7\frac{7}{15}$	1276	$1\frac{109}{210}$	1	$8\frac{32}{105}$	1320	$1\frac{4}{7}$	1	$9\frac{1}{7}$
45	1215	$1\frac{25}{56}$	1	$7\frac{1}{7}$	1260	$1\frac{1}{2}$	1	8	1305	$1\frac{31}{56}$	1	$8\frac{6}{7}$	1350	$1\frac{17}{28}$	1	$9\frac{5}{7}$
48	1296	$1\frac{19}{35}$	1	$8\frac{24}{35}$	1344	$1\frac{9}{15}$	1	$9\frac{9}{15}$	1392	$1\frac{138}{210}$	1	$10\frac{18}{35}$	1440	$1\frac{5}{7}$	1	$11\frac{3}{7}$
50	1350	$1\frac{17}{28}$	1	$9\frac{5}{7}$	1400	$1\frac{2}{3}$	1	$10\frac{2}{3}$	1450	$1\frac{61}{84}$	1	$11\frac{13}{21}$	1500	$1\frac{11}{14}$	1	$12\frac{4}{7}$
55	1485	$1\frac{43}{56}$	1	$12\frac{2}{7}$	1540	$1\frac{5}{6}$	1	$13\frac{1}{8}$	1595	$1\frac{151}{168}$	1	$14\frac{8}{21}$	1650	$1\frac{27}{28}$	1	$15\frac{3}{7}$
60	1620	$1\frac{13}{14}$	1	$14\frac{6}{7}$	1680	2	2	3	1740	$2\frac{1}{14}$	2	$1\frac{2}{7}$	1800	$2\frac{1}{7}$	2	$2\frac{2}{7}$
65	1755	$2\frac{5}{56}$	2	$1\frac{3}{7}$	1820	$2\frac{1}{6}$	2	$2\frac{2}{3}$	1885	$2\frac{41}{168}$	2	$3\frac{19}{21}$	1950	$2\frac{9}{28}$	2	$5\frac{1}{7}$
70	1890	$2\frac{1}{4}$	2	4	1960	$2\frac{1}{3}$	2	$5\frac{1}{3}$	2030	$2\frac{5}{12}$	2	$6\frac{2}{3}$	2100	$2\frac{1}{2}$	2	8
75	2025	$2\frac{23}{56}$	2	$6\frac{4}{7}$	2100	$2\frac{1}{2}$	2	8	2175	$2\frac{33}{56}$	2	$9\frac{3}{7}$	2250	$2\frac{19}{28}$	2	$10\frac{6}{7}$
80	2160	$2\frac{4}{7}$	2	$9\frac{1}{7}$	2240	$2\frac{2}{3}$	2	$10\frac{2}{3}$	2320	$2\frac{16}{21}$	2	$12\frac{4}{21}$	2400	$2\frac{6}{7}$	2	$13\frac{5}{7}$
85	2295	$2\frac{41}{56}$	2	$11\frac{5}{7}$	2380	$2\frac{5}{6}$	2	$13\frac{1}{3}$	2465	$2\frac{157}{168}$	2	$14\frac{20}{21}$	2550	$3\frac{1}{28}$	3	$\frac{4}{7}$
90	2430	$2\frac{25}{28}$	2	$14\frac{2}{7}$	2520	3	3		2610	$3\frac{3}{28}$	3	$1\frac{5}{7}$	2700	$3\frac{3}{14}$	3	$3\frac{3}{7}$
95	2565	$3\frac{3}{56}$	3	$\frac{6}{7}$	2660	$3\frac{1}{6}$	3	$2\frac{2}{3}$	2755	$3\frac{47}{168}$	3	$4\frac{10}{21}$	2850	$3\frac{11}{28}$	3	$6\frac{2}{7}$
100	2700	$3\frac{3}{14}$	3	$3\frac{3}{7}$	2800	$3\frac{1}{3}$	3	$5\frac{3}{8}$	2900	$3\frac{19}{42}$	3	$7\frac{5}{21}$	3000	$3\frac{4}{7}$	3	$9\frac{1}{7}$
105	2835	$3\frac{3}{8}$	3	6	2940	$3\frac{1}{2}$	3	8	3045	$3\frac{5}{8}$	3	10	3150	$3\frac{3}{4}$	3	12
110	2970	$3\frac{15}{28}$	3	$8\frac{4}{7}$	3080	$3\frac{2}{3}$	3	$10\frac{2}{3}$	3190	$3\frac{67}{84}$	3	$12\frac{16}{21}$	3300	$3\frac{39}{42}$	3	$14\frac{6}{7}$
115	3105	$3\frac{39}{56}$	3	$11\frac{1}{7}$	3220	$3\frac{5}{6}$	3	$13\frac{1}{3}$	3335	$3\frac{163}{168}$	3	$15\frac{11}{21}$	3450	$4\frac{3}{28}$	4	$1\frac{5}{7}$
120	3240	$3\frac{6}{7}$	3	$13\frac{5}{7}$	3360	4	4		3480	$4\frac{1}{7}$	4	$2\frac{2}{7}$	3600	$4\frac{2}{7}$	4	$4\frac{4}{7}$
125	3375	$4\frac{1}{56}$	4	$\frac{2}{7}$	3500	$4\frac{1}{6}$	4	$2\frac{2}{3}$	3625	$4\frac{53}{168}$	4	$5\frac{1}{21}$	3750	$4\frac{13}{28}$	4	$7\frac{3}{7}$
130	3510	$4\frac{5}{28}$	4	$2\frac{6}{7}$	3640	$4\frac{1}{3}$	4	$5\frac{1}{3}$	3770	$4\frac{41}{84}$	4	$7\frac{17}{21}$	3900	$4\frac{9}{14}$	4	$10\frac{2}{7}$
135	3645	$4\frac{19}{56}$	4	$5\frac{3}{7}$	3780	$4\frac{1}{2}$	4	8	3915	$4\frac{111}{168}$	4	$10\frac{4}{7}$	4050	$4\frac{23}{28}$	4	$13\frac{1}{7}$
140	3780	$4\frac{1}{2}$	4	8	3920	$4\frac{2}{3}$	4	$10\frac{2}{3}$	4060	$4\frac{5}{6}$	4	$13\frac{1}{3}$	4200	5	5	
145	3915	$4\frac{37}{56}$	4	$10\frac{4}{7}$	4060	$4\frac{5}{6}$	4	$13\frac{1}{3}$	4205	$5\frac{1}{168}$	5	$\frac{2}{21}$	4350	$5\frac{5}{28}$	5	$2\frac{6}{7}$
150	4050	$4\frac{23}{28}$	4	$13\frac{1}{7}$	4200	5	5		4350	$5\frac{5}{28}$	5	$2\frac{6}{7}$	4500	$5\frac{5}{14}$	5	$5\frac{5}{7}$

Table of Warp or Filling Yarn Required for One Yard Square of Cloth with No. 1 Yarn, in Yards, Hanks, Pounds and Ounces.—For Cotton Yarn.

Th'ds per Inch.	Width of Goods, 31 Inches.				Width of Goods, 32 Inches.				Width of Goods, 33 Inches.				Width of Goods, 34 Inches.			
	Yards.	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.
20	620	31/42		11 17/21	640	16/21		12 4/21	660	33/42		12 4/7	680	17/21		12 20/21
24	744	31/35		14 6/35	768	32/35		14 22/35	792	33/35		15 3/35	816	34/35		15 19/35
25	775	157/168		14 25/28	800	20/21		15 5/21	825	165/168		15 5/7	850	1 1/84	1	4/21
28	868	1 1/30	1	8/15	896	1 1/15	1	1 1/15	924	1 1/10	1	1 3/5	952	1 2/15	1	2 2/15
30	930	1 3/28	1	1 5/7	960	1 1/7	1	2 2/7	990	1 5/28	1	2 6/7	1020	1 3/14	1	3 3/7
32	992	1 19/105	1	2 94/105	1024	1 23/105	1	3 53/105	1056	1 9/35	1	4 4/35	1088	1 31/105	1	4 76/105
35	1085	1 7/24	1	4 2/3	1120	1 1/3	1	5 1/3	1155	1 3/8	1	6	1190	1 5/12	1	6 2/3
36	1116	1 23/70	1	5 9/35	1152	1 13/35	1	5 33/35	1188	1 29/70	1	6 22/35	1224	1 16/35	1	7 11/35
40	1240	1 10/21	1	7 13/21	1280	1 11/21	1	8 8/21	1320	1 4/7	1	9 1/7	1360	1 13/21	1	9 6/7
44	1364	1 131/210	1	9 103/105	1408	1 142/210	1	10 86/105	1452	1 51/70	1	11 23/35	1496	1 82/105	1	12 52/105
45	1395	1 111/168	1	10 4/7	1440	1 5/7	1	11 3/7	1485	1 131/168	1	12 10/21	1530	1 23/28	1	13 1/7
48	1488	1 27/35	1	12 12/35	1536	1 4/5	1	12 4/5	1584	1 93/105	1	14 6/35	1632	1 33/35	1	15 3/35
50	1550	1 71/84	1	13 11/21	1600	1 19/21	1	14 10/21	1650	1 27/28	1	15 1/4	1700	2 1/42	2	8/21
55	1705	2 5/168	2	10/21	1760	2 2/21	2	1 11/21	1815	2 9/56	2	2 4/7	1870	2 19/84	2	3 13/21
60	1860	2 3/14	2	3 3/7	1920	2 2/7	2	4 4/7	1980	1 5/14	2	5 5/7	2040	2 3/7	2	6 6/7
65	2015	2 67/168	2	6 8/21	2080	2 10/21	2	7 13/21	2145	2 31/56	2	8 6/7	2210	2 53/84	2	10 2/21
70	2170	2 7/12	2	9 1/3	2240	2 2/3	2	10 2/3	2310	2 3/4	2	12	2380	2 5/6	2	13 1/3
75	2325	2 43/56	2	12 2/7	2400	2 6/7	2	13 5/7	2475	2 53/56	2	15 1/7	2550	3 1/28	3	4/7
80	2480	2 20/21	2	15 5/21	2560	3 1/21	3	16/21	2640	3 1/7	3	2 2/7	2720	3 5/21	3	3 17/21
85	2635	3 23/168	3	2 4/21	2720	3 5/21	3	3 17/21	2805	3 57/168	3	5 3/7	2890	3 37/84	3	7 1/21
90	2790	3 9/28	3	5 1/7	2880	3 3/7	3	6 18/21	2970	3 15/28	3	8 4/7	3060	3 9/14	3	10 2/7
95	2945	3 85/168	3	8 2/21	3040	3 13/21	3	9 19/21	3135	3 41/56	3	11 5/7	3230	3 71/84	3	13 11/21
100	3100	3 29/42	3	11 1/21	3200	3 17/21	3	12 20/21	3300	3 39/42	3	14 6/7	3400	4 1/21	4	16/21
105	3255	3 7/8	3	14	3360	4	4		3465	4 1/8	4	2	3570	4 1/4	4	4
110	3410	4 5/84	4	20/21	3520	4 4/21	4	3 1/21	3630	4 9/28	4	5 1/7	3740	4 19/42	4	7 5/21
115	3565	4 41/168	4	3 19/21	3680	4 8/21	4	6 2/21	3795	4 21/56	4	8 2/7	3910	4 55/84	4	10 10/21
120	3720	4 3/7	4	6 18/21	3840	4 4/7	4	9 1/7	3960	4 5/7	4	11 3/7	4080	4 6/7	4	13 5/7
125	3875	4 103/168	4	9 17/21	4000	4 16/21	4	12 4/21	4125	4 51/56	4	14 4/7	4250	5 5/84	5	20/21
130	4030	4 67/84	4	12 16/21	4160	4 20/21	4	15 5/21	4290	5 3/28	5	1 5/7	4420	5 11/42	5	4 4/21
135	4185	4 165/168	4	15 5/7	4320	5 1/7	5	2 2/7	4455	5 17/56	5	4 6/7	4590	5 13/28	5	7 3/7
140	4340	5 1/6	5	2 2/3	4480	5 1/3	5	5 1/3	4620	5 1/2	5	8	4760	5 2/3	5	10 2/3
145	4495	5 59/168	5	5 13/21	4640	5 11/21	5	8 8/21	4785	5 39/56	5	11 1/7	4930	5 73/84	5	13 19/21
150	4650	5 45/84	5	8 4/7	4800	5 5/7	5	11 3/7	4950	5 25/28	5	14 2/7	5100	6 1/14	6	1 1/7

Table of Warp or Filling Yarn Required for One Yard Square of Cloth with No. 1 Yarn, in Yards, Hanks, Pounds and Ounces.—For Cotton Yarn.

Th'ds per Inch.	Width of Goods, 35 Inches.				Width of Goods 36 Inches.			
	Yards.	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.
20	700	$\frac{5}{6}$		$13\frac{1}{3}$	720	$\frac{6}{7}$		$13\frac{5}{7}$
24	840	1	1		864	$1\frac{1}{35}$	1	$\frac{16}{35}$
25	875	$1\frac{1}{24}$	1	$\frac{2}{3}$	900	$1\frac{1}{14}$	1	$1\frac{2}{7}$
28	980	$1\frac{1}{6}$	1	$2\frac{2}{3}$	1008	$1\frac{1}{5}$	1	$3\frac{1}{5}$
30	1050	$1\frac{1}{4}$	1	4	1080	$1\frac{2}{7}$	1	$4\frac{4}{7}$
32	1120	$1\frac{1}{3}$	1	$5\frac{1}{3}$	1152	$1\frac{13}{35}$	1	$5\frac{33}{35}$
35	1225	$1\frac{11}{24}$	1	$7\frac{1}{3}$	1260	$1\frac{1}{2}$	1	8
36	1260	$1\frac{1}{2}$	1	8	1296	$1\frac{19}{35}$	1	$8\frac{24}{35}$
40	1400	$1\frac{2}{3}$	1	$10\frac{2}{3}$	1440	$1\frac{5}{7}$	1	$11\frac{3}{7}$
44	1540	$1\frac{5}{6}$	1	$13\frac{1}{3}$	1584	$1\frac{31}{35}$	1	$14\frac{6}{35}$
45	1575	$1\frac{7}{8}$	1	14	1620	$1\frac{13}{14}$	1	$14\frac{6}{7}$
48	1680	2	2		1728	$2\frac{2}{35}$	2	$\frac{32}{35}$
50	1750	$2\frac{1}{12}$	2	$1\frac{1}{3}$	1800	$2\frac{1}{7}$	2	$2\frac{2}{7}$
55	1925	$2\frac{7}{24}$	2	$4\frac{2}{3}$	1980	$2\frac{5}{14}$	2	$5\frac{5}{14}$
60	2100	$2\frac{1}{2}$	2	8	2160	$2\frac{4}{7}$	2	$9\frac{1}{7}$
65	2275	$2\frac{17}{24}$	2	$11\frac{1}{3}$	2340	$2\frac{11}{14}$	2	$12\frac{4}{7}$
70	2450	$2\frac{11}{12}$	2	$14\frac{2}{3}$	2520	3	3	
75	2625	$3\frac{1}{8}$	3	2	2700	$3\frac{3}{14}$	3	$3\frac{3}{7}$
80	2800	$3\frac{1}{3}$	3	$5\frac{1}{3}$	2880	$3\frac{3}{7}$	3	$6\frac{6}{7}$
85	2975	$3\frac{13}{24}$	3	$8\frac{2}{3}$	3060	$3\frac{9}{14}$	3	$10\frac{2}{7}$
90	3150	$3\frac{3}{4}$	3	12	3240	$3\frac{6}{7}$	3	$13\frac{5}{7}$
95	3325	$3\frac{23}{24}$	3	$15\frac{1}{3}$	3420	$4\frac{1}{14}$	4	$1\frac{1}{7}$
100	3500	$4\frac{1}{6}$	4	$2\frac{2}{3}$	3600	$4\frac{2}{7}$	4	$4\frac{4}{7}$
105	3675	$4\frac{3}{8}$	4	6	3780	$4\frac{1}{2}$	4	8
110	3850	$4\frac{7}{12}$	4	$9\frac{1}{3}$	3960	$4\frac{5}{7}$	4	$11\frac{3}{7}$
115	4025	$4\frac{19}{24}$	4	$12\frac{2}{3}$	4140	$4\frac{13}{14}$	4	$14\frac{6}{7}$
120	4200	5	5		4320	$5\frac{1}{7}$	5	$2\frac{2}{7}$
125	4375	$5\frac{5}{24}$	5	$3\frac{1}{3}$	4500	$5\frac{5}{14}$	5	$5\frac{5}{7}$
130	4550	$5\frac{5}{12}$	5	$6\frac{2}{3}$	4680	$5\frac{4}{7}$	5	$9\frac{1}{7}$
135	4725	$5\frac{15}{24}$	5	10	4860	$5\frac{11}{14}$	5	$12\frac{4}{7}$
140	4900	$5\frac{5}{6}$	5	$13\frac{1}{3}$	5040	6	6	
145	5075	$6\frac{1}{24}$	6	$\frac{2}{3}$	5220	$6\frac{3}{14}$	6	$3\frac{3}{7}$
150	5250	$6\frac{1}{4}$	6	4	5400	$6\frac{3}{7}$	6	$6\frac{6}{7}$

Th'ds per Inch.	Width of Goods, 37 Inches.				Width of Goods, 38 Inches.			
	Yards.	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.
20	740	$\frac{37}{42}$		$14\frac{2}{21}$	760	$\frac{19}{21}$		$14\frac{10}{21}$
24	888	$1\frac{2}{35}$	1	$\frac{32}{35}$	912	$1\frac{3}{35}$	1	$1\frac{13}{35}$
25	925	$1\frac{17}{168}$	1	$1\frac{13}{21}$	950	$1\frac{11}{84}$	1	$2\frac{2}{21}$
28	1036	$1\frac{7}{30}$	1	$3\frac{11}{15}$	1064	$1\frac{4}{15}$	1	$4\frac{4}{15}$
30	1110	$1\frac{23}{84}$	1	$4\frac{8}{21}$	1140	$1\frac{5}{14}$	1	$5\frac{5}{7}$
32	1184	$1\frac{43}{105}$	1	$6\frac{58}{105}$	1216	$1\frac{47}{105}$	1	$7\frac{17}{105}$
35	1295	$1\frac{13}{24}$	1	$8\frac{2}{3}$	1330	$1\frac{7}{12}$	1	$9\frac{1}{3}$
36	1332	$1\frac{41}{70}$	1	$9\frac{13}{35}$	1368	$1\frac{22}{35}$	1	$10\frac{2}{35}$
40	1480	$1\frac{16}{21}$	1	$12\frac{4}{21}$	1520	$1\frac{17}{21}$	1	$12\frac{20}{21}$
44	1628	$1\frac{197}{210}$	1	$14\frac{53}{70}$	1672	$1\frac{104}{105}$	1	$15\frac{89}{105}$
45	1665	$1\frac{55}{56}$	1	$15\frac{6}{7}$	1710	$2\frac{1}{28}$	2	$\frac{4}{7}$
48	1776	$2\frac{4}{35}$	2	$1\frac{29}{35}$	1824	$2\frac{6}{35}$	2	$2\frac{26}{35}$
50	1850	$2\frac{17}{84}$	2	$3\frac{5}{21}$	1900	$2\frac{11}{42}$	2	$4\frac{4}{21}$
55	2035	$2\frac{71}{168}$	2	$6\frac{16}{21}$	2090	$2\frac{41}{84}$	2	$7\frac{17}{21}$
60	2220	$2\frac{9}{14}$	2	$10\frac{2}{7}$	2280	$2\frac{5}{7}$	2	$11\frac{3}{7}$
65	2405	$2\frac{145}{168}$	2	$13\frac{17}{21}$	2470	$2\frac{79}{84}$	2	$15\frac{1}{21}$
70	2590	$3\frac{1}{12}$	3	$1\frac{1}{3}$	2660	$3\frac{1}{6}$	3	$2\frac{2}{3}$
75	2775	$3\frac{17}{56}$	3	$4\frac{6}{7}$	2850	$3\frac{11}{28}$	3	$6\frac{2}{7}$
80	2960	$3\frac{11}{21}$	3	$8\frac{8}{21}$	3040	$3\frac{13}{21}$	3	$9\frac{19}{21}$
85	3145	$3\frac{125}{168}$	3	$11\frac{19}{21}$	3230	$3\frac{71}{84}$	3	$13\frac{11}{21}$
90	3330	$3\frac{81}{84}$	3	$15\frac{3}{7}$	3420	$4\frac{1}{14}$	4	$1\frac{1}{7}$
95	3515	$4\frac{31}{168}$	4	$2\frac{20}{21}$	3610	$4\frac{25}{84}$	4	$4\frac{16}{21}$
100	3700	$4\frac{17}{42}$	4	$6\frac{10}{21}$	3800	$4\frac{11}{21}$	4	$8\frac{8}{21}$
105	3885	$4\frac{5}{8}$	4	10	3990	$4\frac{3}{4}$	4	12
110	4070	$4\frac{71}{84}$	4	$13\frac{11}{21}$	4180	$4\frac{41}{42}$	4	$15\frac{13}{21}$
115	4255	$5\frac{11}{168}$	5	$1\frac{1}{21}$	4370	$5\frac{17}{84}$	5	$3\frac{5}{21}$
120	4440	$5\frac{2}{7}$	5	$4\frac{4}{7}$	4560	$5\frac{3}{7}$	5	$6\frac{6}{7}$
125	4625	$5\frac{85}{168}$	5	$8\frac{2}{21}$	4750	$5\frac{55}{84}$	5	$10\frac{10}{21}$
130	4810	$5\frac{61}{84}$	5	$11\frac{13}{21}$	4940	$5\frac{37}{42}$	5	$14\frac{2}{21}$
135	4995	$5\frac{53}{56}$	5	$15\frac{1}{7}$	5130	$6\frac{3}{28}$	6	$1\frac{5}{7}$
140	5180	$6\frac{1}{6}$	6	$2\frac{2}{3}$	5320	$6\frac{1}{3}$	6	$5\frac{1}{3}$
145	5365	$6\frac{65}{168}$	6	$6\frac{4}{21}$	5510	$6\frac{47}{84}$	6	$8\frac{20}{21}$
150	5550	$6\frac{17}{28}$	6	$9\frac{5}{7}$	5700	$6\frac{11}{14}$	6	$12\frac{4}{7}$

Table of Warp or Filling Yarn Required for One Yard of Cloth with No. 1 Yarn, in Yards, Hanks, Pounds and Ounces.—For Cotton Yarn.

Th'ds per Inch.	Width of Goods, 39 Inches.				Width of Goods 40 Inches.				Width of Goods, 41 Inches.				Width of Goods, 42 Inches.			
	Yards.	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.	Yards.	H'nks	Lbs.	Oz.
20	780	$\frac{39}{42}$		$14\frac{6}{7}$	800	$\frac{20}{21}$		$15\frac{5}{21}$	820	$\frac{41}{42}$		$15\frac{13}{21}$	840	1	1	
24	936	$1\frac{4}{35}$	1	$1\frac{13}{35}$	960	$1\frac{1}{7}$	1	$2\frac{2}{7}$	984	$1\frac{6}{35}$	1	$2\frac{26}{35}$	1008	$1\frac{1}{5}$	1	$3\frac{1}{5}$
25	975	$1\frac{9}{56}$	1	$2\frac{4}{7}$	1000	$1\frac{4}{21}$	1	$3\frac{1}{21}$	1025	$1\frac{37}{168}$	1	$3\frac{11}{21}$	1050	$1\frac{1}{4}$	1	4
28	1092	$1\frac{3}{10}$	1	$4\frac{4}{5}$	1120	$1\frac{1}{3}$	1	$5\frac{1}{3}$	1148	$1\frac{11}{30}$	1	$5\frac{13}{15}$	1176	$1\frac{2}{5}$	1	$6\frac{2}{5}$
30	1170	$1\frac{11}{28}$	1	$6\frac{2}{7}$	1200	$1\frac{3}{7}$	1	$6\frac{6}{7}$	1230	$1\frac{13}{28}$	1	$7\frac{3}{7}$	1260	$1\frac{1}{2}$	1	8
32	1248	$1\frac{17}{35}$	1	$7\frac{27}{35}$	1280	$1\frac{11}{21}$	1	$8\frac{8}{21}$	1312	$1\frac{59}{105}$	1	$8\frac{104}{105}$	1344	$1\frac{3}{5}$	1	$9\frac{3}{5}$
35	1365	$1\frac{5}{8}$	1	10	1400	$1\frac{2}{3}$	1	$10\frac{2}{3}$	1435	$1\frac{17}{24}$	1	$11\frac{1}{3}$	1470	$1\frac{3}{4}$	1	12
36	1404	$1\frac{47}{70}$	1	$10\frac{26}{35}$	1440	$1\frac{5}{7}$	1	$11\frac{3}{7}$	1476	$1\frac{53}{70}$	1	$12\frac{4}{35}$	1512	$1\frac{4}{5}$	1	$12\frac{4}{5}$
40	1560	$1\frac{6}{7}$	1	$13\frac{5}{7}$	1600	$1\frac{19}{21}$	1	$14\frac{10}{21}$	1640	$1\frac{20}{21}$	1	$15\frac{5}{21}$	1680	2	2	
44	1716	$2\frac{3}{70}$	2	$\frac{24}{35}$	1760	$2\frac{2}{21}$	2	$1\frac{11}{21}$	1804	$2\frac{31}{210}$	2	$2\frac{38}{105}$	1848	$2\frac{1}{5}$	2	$3\frac{1}{5}$
45	1755	$2\frac{5}{56}$	2	$1\frac{3}{7}$	1800	$2\frac{1}{7}$	2	$2\frac{2}{7}$	1845	$2\frac{11}{56}$	2	$3\frac{1}{7}$	1890	$2\frac{1}{4}$	2	4
48	1872	$2\frac{8}{35}$	2	$3\frac{23}{35}$	1920	$2\frac{2}{7}$	2	$4\frac{4}{7}$	1968	$2\frac{12}{35}$	2	$5\frac{17}{35}$	2016	$2\frac{2}{5}$	2	$6\frac{2}{5}$
50	1950	$2\frac{9}{28}$	2	$5\frac{1}{7}$	2000	$2\frac{8}{21}$	2	$6\frac{2}{21}$	2050	$2\frac{37}{84}$	2	$7\frac{1}{21}$	2100	$2\frac{1}{2}$	2	8
55	2145	$2\frac{31}{56}$	2	$8\frac{6}{7}$	2200	$2\frac{13}{21}$	2	$9\frac{6}{7}$	2255	$2\frac{115}{168}$	2	$10\frac{20}{21}$	2310	$2\frac{3}{4}$	2	12
60	2340	$2\frac{11}{14}$	2	$12\frac{4}{7}$	2400	$2\frac{6}{7}$	2	$13\frac{5}{7}$	2460	$2\frac{39}{42}$	2	$14\frac{6}{7}$	2520	3	3	
65	2535	$3\frac{1}{56}$	3	$\frac{2}{7}$	2600	$3\frac{2}{21}$	3	$1\frac{11}{21}$	2665	$3\frac{29}{168}$	3	$2\frac{16}{21}$	2730	$3\frac{1}{4}$	3	4
70	2730	$3\frac{1}{4}$	3	4	2800	$3\frac{1}{3}$	3	$5\frac{1}{3}$	2870	$3\frac{5}{12}$	3	$6\frac{2}{3}$	2940	$3\frac{1}{2}$	3	8
75	2925	$3\frac{27}{56}$	3	$7\frac{5}{7}$	3000	$3\frac{4}{7}$	3	$9\frac{1}{7}$	3075	$3\frac{37}{56}$	3	$10\frac{4}{7}$	3150	$3\frac{3}{4}$	3	12
80	3120	$3\frac{5}{7}$	3	$11\frac{3}{7}$	3200	$3\frac{17}{21}$	3	$12\frac{20}{21}$	3280	$3\frac{19}{21}$	3	$14\frac{10}{21}$	3360	4	4	
85	3315	$3\frac{53}{56}$	3	$15\frac{1}{7}$	3400	$4\frac{1}{21}$	4	$\frac{16}{21}$	3485	$4\frac{25}{168}$	4	$2\frac{8}{21}$	3570	$4\frac{1}{4}$	4	4
90	3510	$4\frac{5}{28}$	4	$2\frac{6}{7}$	3600	$4\frac{2}{7}$	4	$4\frac{4}{7}$	3690	$4\frac{11}{28}$	4	$6\frac{2}{7}$	3780	$4\frac{1}{2}$	4	8
95	3705	$4\frac{23}{56}$	4	$6\frac{4}{7}$	3800	$4\frac{11}{21}$	4	$8\frac{8}{21}$	3895	$4\frac{107}{168}$	4	$10\frac{4}{21}$	3990	$4\frac{3}{4}$	4	12
100	3900	$4\frac{9}{14}$	4	$10\frac{2}{7}$	4000	$4\frac{16}{21}$	4	$12\frac{4}{21}$	4100	$4\frac{37}{42}$	4	$14\frac{2}{21}$	4200	5	5	
105	4095	$4\frac{7}{8}$	4	14	4200	5	5		4305	$5\frac{1}{8}$	5	2	4410	$5\frac{1}{4}$	5	4
110	4290	$5\frac{3}{28}$	5	$1\frac{5}{7}$	4400	$5\frac{5}{21}$	5	$3\frac{17}{21}$	4510	$5\frac{31}{84}$	5	$5\frac{19}{21}$	4620	$5\frac{1}{2}$	5	8
115	4485	$5\frac{19}{56}$	5	$5\frac{3}{7}$	4600	$5\frac{10}{21}$	5	$7\frac{13}{21}$	4715	$5\frac{103}{168}$	5	$9\frac{17}{21}$	4830	$5\frac{3}{4}$	5	12
120	4680	$5\frac{4}{7}$	5	$9\frac{1}{7}$	4800	$5\frac{5}{7}$	5	$11\frac{3}{7}$	4920	$5\frac{6}{7}$	5	$13\frac{5}{7}$	5040	6	6	
125	4875	$5\frac{45}{56}$	5	$12\frac{6}{7}$	5000	$5\frac{20}{21}$	5	$15\frac{5}{21}$	5125	$6\frac{17}{168}$	6	$1\frac{13}{21}$	5250	$6\frac{1}{4}$	6	4
130	5070	$6\frac{1}{28}$	6	$\frac{4}{7}$	5200	$6\frac{4}{21}$	6	$3\frac{1}{21}$	5330	$6\frac{29}{84}$	6	$5\frac{11}{21}$	5460	$6\frac{1}{2}$	6	8
135	5265	$6\frac{15}{56}$	6	$4\frac{2}{7}$	5400	$6\frac{3}{7}$	6	$6\frac{6}{7}$	5535	$6\frac{33}{56}$	6	$9\frac{3}{7}$	5670	$6\frac{3}{4}$	6	12
140	5460	$6\frac{1}{2}$	6	8	5600	$6\frac{8}{12}$	6	$10\frac{2}{3}$	5740	$6\frac{5}{6}$	6	$13\frac{1}{3}$	5880	7	7	
145	5655	$6\frac{41}{56}$	6	$11\frac{5}{7}$	5800	$6\frac{19}{21}$	6	$14\frac{10}{21}$	5945	$7\frac{13}{168}$	7	$1\frac{5}{21}$	6090	$7\frac{1}{4}$	7	4
150	5850	$6\frac{27}{28}$	6	$15\frac{3}{7}$	6000	$7\frac{1}{7}$	7	$2\frac{2}{7}$	6150	$7\frac{9}{28}$	7	$5\frac{1}{7}$	6300	$7\frac{1}{2}$	7	8

Table of Warp or Filling Yarn Required to Make One Yard of Cloth with No. 1 Yarn, in Yards, Runs, Pounds and Ounces.—For Woolen Yarn.

Th'ds per Inch.	Width of Goods, 27 Inches.				Width of Goods, 28 Inches.				Width of Goods, 29 Inches.				Width of Goods, 30 Inches.			
	Yards.	Runs.	Lbs.	Oz.	Yards.	Runs	Lbs.	Oz.	Yards.	Runs.	Lbs.	Oz.	Yards.	Runs.	Lbs.	Oz.
20	540	$\frac{27}{80}$		$5\frac{2}{5}$	560	$\frac{7}{20}$		$5\frac{3}{5}$	580	$\frac{29}{80}$		$5\frac{4}{5}$	600	$\frac{3}{8}$		6
24	648	$\frac{81}{200}$		$6\frac{12}{25}$	672	$\frac{21}{50}$		$6\frac{18}{25}$	696	$\frac{87}{200}$		$6\frac{24}{25}$	720	$\frac{9}{20}$		$7\frac{1}{5}$
25	675	$\frac{27}{64}$		$6\frac{3}{4}$	700	$\frac{7}{16}$		7	725	$\frac{29}{64}$		$7\frac{1}{4}$	750	$\frac{15}{32}$		$7\frac{1}{2}$
28	756	$\frac{189}{400}$		$7\frac{14}{25}$	784	$\frac{49}{100}$		$7\frac{21}{25}$	812	$\frac{203}{400}$		$8\frac{3}{25}$	840	$\frac{21}{40}$		$8\frac{2}{5}$
30	810	$\frac{81}{160}$		$8\frac{1}{10}$	840	$\frac{21}{40}$		$8\frac{2}{5}$	870	$\frac{87}{160}$		$8\frac{7}{10}$	900	$\frac{9}{16}$		9
32	864	$\frac{27}{50}$		$8\frac{16}{25}$	896	$\frac{14}{25}$		$8\frac{24}{25}$	928	$\frac{29}{50}$		$9\frac{7}{25}$	960	$\frac{3}{5}$		$9\frac{3}{5}$
35	945	$\frac{189}{320}$		$9\frac{9}{20}$	980	$\frac{49}{80}$		$9\frac{4}{5}$	1015	$\frac{203}{320}$		$10\frac{3}{20}$	1050	$\frac{21}{32}$		$10\frac{1}{2}$
36	972	$\frac{243}{400}$		$9\frac{18}{25}$	1008	$\frac{63}{100}$		$10\frac{2}{25}$	1044	$\frac{261}{400}$		$10\frac{11}{25}$	1080	$\frac{27}{40}$		$10\frac{4}{5}$
40	1080	$\frac{27}{40}$		$10\frac{4}{5}$	1120	$\frac{7}{10}$		$11\frac{1}{5}$	1160	$\frac{29}{40}$		$11\frac{3}{5}$	1200	$\frac{3}{4}$		12
44	1188	$\frac{297}{400}$		$11\frac{22}{25}$	1232	$\frac{77}{100}$		$12\frac{8}{25}$	1276	$\frac{319}{400}$		$12\frac{19}{25}$	1320	$\frac{33}{40}$		$13\frac{1}{5}$
45	1215	$\frac{243}{320}$		$12\frac{3}{20}$	1260	$\frac{63}{80}$		$12\frac{3}{5}$	1305	$\frac{261}{320}$		$13\frac{1}{20}$	1350	$\frac{27}{32}$		$13\frac{1}{2}$
48	1296	$\frac{81}{100}$		$12\frac{24}{25}$	1344	$\frac{21}{25}$		$13\frac{11}{25}$	1392	$\frac{87}{100}$		$13\frac{23}{25}$	1440	$\frac{9}{10}$		$14\frac{2}{5}$
50	1350	$\frac{27}{32}$		$13\frac{1}{2}$	1400	$\frac{7}{8}$		14	1450	$\frac{29}{32}$		$14\frac{1}{2}$	1500	$\frac{15}{16}$		15
55	1485	$\frac{297}{320}$		$14\frac{17}{20}$	1540	$\frac{77}{80}$		$15\frac{2}{5}$	1595	$\frac{319}{320}$		$15\frac{19}{20}$	1650	$1\frac{1}{32}$	1	$\frac{1}{2}$
60	1620	$1\frac{1}{80}$	1	$\frac{1}{5}$	1680	$1\frac{1}{20}$	1	$\frac{4}{5}$	1740	$1\frac{7}{80}$	1	$1\frac{2}{5}$	1800	$1\frac{1}{8}$	1	2
65	1755	$1\frac{31}{320}$	1	$1\frac{11}{20}$	1820	$1\frac{11}{80}$	1	$2\frac{1}{5}$	1885	$1\frac{57}{320}$	1	$2\frac{17}{20}$	1950	$1\frac{35}{160}$	1	$3\frac{1}{2}$
70	1890	$1\frac{29}{160}$	1	$2\frac{9}{10}$	1960	$1\frac{9}{40}$	1	$3\frac{3}{5}$	2030	$1\frac{43}{160}$	1	$4\frac{3}{10}$	2100	$1\frac{5}{16}$	1	5
75	2025	$1\frac{17}{64}$	1	$4\frac{1}{4}$	2100	$1\frac{5}{16}$	1	5	2175	$1\frac{23}{64}$	1	$5\frac{3}{4}$	2250	$1\frac{13}{32}$	1	$6\frac{1}{2}$
80	2160	$1\frac{7}{20}$	1	$5\frac{3}{5}$	2240	$1\frac{2}{5}$	1	$6\frac{2}{5}$	2320	$1\frac{9}{20}$	1	$7\frac{1}{5}$	2400	$1\frac{1}{2}$	1	8
85	2295	$1\frac{139}{320}$	1	$6\frac{19}{20}$	2380	$1\frac{39}{80}$	1	$7\frac{4}{5}$	2465	$1\frac{173}{320}$	1	$8\frac{13}{20}$	2550	$1\frac{19}{32}$	1	$9\frac{1}{2}$
90	2430	$1\frac{83}{160}$	1	$8\frac{3}{10}$	2520	$1\frac{23}{40}$	1	$9\frac{1}{5}$	2610	$1\frac{101}{160}$	1	$10\frac{1}{10}$	2700	$1\frac{11}{16}$	1	11
95	2565	$1\frac{193}{320}$	1	$9\frac{13}{20}$	2660	$1\frac{53}{80}$	1	$10\frac{3}{5}$	2755	$1\frac{231}{320}$	1	$11\frac{11}{20}$	2850	$1\frac{25}{32}$	1	$12\frac{1}{2}$
100	2700	$1\frac{11}{16}$	1	11	2800	$1\frac{3}{4}$	1	12	2900	$1\frac{13}{16}$	1	13	3000	$1\frac{7}{8}$	1	14
105	2835	$1\frac{247}{320}$	1	$12\frac{7}{20}$	2940	$1\frac{67}{80}$	1	$13\frac{2}{5}$	3045	$1\frac{289}{320}$	1	$14\frac{9}{20}$	3150	$1\frac{31}{32}$	1	$15\frac{1}{2}$
110	2970	$1\frac{137}{160}$	1	$13\frac{7}{10}$	3080	$1\frac{37}{40}$	1	$14\frac{4}{5}$	3190	$1\frac{159}{160}$	1	$15\frac{9}{10}$	3300	$2\frac{1}{16}$	2	1
115	3105	$1\frac{301}{320}$	1	$15\frac{1}{20}$	3220	$2\frac{1}{80}$	2	$\frac{1}{5}$	3335	$2\frac{27}{320}$	2	$1\frac{7}{20}$	3450	$2\frac{5}{32}$	2	$2\frac{1}{2}$
120	3240	$2\frac{1}{40}$	2	$\frac{2}{5}$	3360	$2\frac{1}{10}$	2	$1\frac{3}{5}$	3480	$2\frac{7}{40}$	2	$2\frac{4}{5}$	3600	$2\frac{1}{4}$	2	4
125	3375	$2\frac{7}{64}$	2	$1\frac{3}{4}$	3500	$2\frac{3}{16}$	2	3	3625	$2\frac{17}{64}$	2	$4\frac{1}{4}$	3750	$2\frac{11}{32}$	2	$5\frac{1}{2}$
130	3510	$2\frac{31}{160}$	2	$3\frac{1}{10}$	3640	$2\frac{11}{40}$	2	$4\frac{2}{5}$	3770	$2\frac{57}{160}$	2	$5\frac{7}{10}$	3900	$2\frac{7}{16}$	2	7
135	3645	$2\frac{89}{320}$	2	$4\frac{9}{20}$	3780	$2\frac{29}{80}$	2	$5\frac{4}{5}$	3915	$2\frac{143}{320}$	2	$7\frac{3}{20}$	4050	$2\frac{17}{32}$	2	$8\frac{1}{2}$
140	3780	$2\frac{29}{80}$	2	$5\frac{4}{5}$	3920	$2\frac{9}{20}$	2	$7\frac{1}{5}$	4060	$2\frac{43}{80}$	2	$8\frac{3}{5}$	4200	$2\frac{5}{8}$	2	10
145	3915	$2\frac{143}{320}$	2	$7\frac{3}{20}$	4060	$2\frac{43}{80}$	2	$8\frac{3}{5}$	4205	$2\frac{201}{320}$	2	$10\frac{1}{20}$	4350	$2\frac{23}{32}$	2	$11\frac{1}{2}$
150	4050	$2\frac{17}{32}$	2	$8\frac{1}{2}$	4200	$2\frac{5}{8}$	2	10	4350	$2\frac{23}{32}$	2	$11\frac{1}{2}$	4500	$2\frac{13}{16}$	2	13

Table of Warp or Filling Yarn Required to Make One Yard of Cloth with No. 1 Yarn, in Yards, Runs, Pounds and Ounces.—For Woolen Yarn.

Th'ds per Inch.	Width of Goods, 31 Inches.				Width of Goods, 32 Inches.				Width of Goods, 33 Inches.				Width of Goods, 34 Inches.			
	Yards.	Runs	Lbs.	Oz.	Yards.	Runs	Lbs.	Oz.	Yards.	Runs.	Lbs.	Oz.	Yards.	Runs	Lbs.	Oz.
20	620	$\frac{31}{80}$		$6\frac{1}{5}$	640	$\frac{2}{5}$		$6\frac{2}{5}$	660	$\frac{33}{80}$		$6\frac{3}{5}$	680	$\frac{17}{40}$		$6\frac{4}{5}$
24	744	$\frac{93}{200}$		$7\frac{11}{25}$	768	$\frac{12}{25}$		$7\frac{17}{25}$	792	$\frac{99}{200}$		$7\frac{23}{25}$	816	$\frac{51}{100}$		$8\frac{4}{25}$
28	868	$\frac{217}{400}$		$8\frac{17}{25}$	896	$\frac{14}{25}$		$8\frac{24}{25}$	924	$\frac{231}{400}$		$9\frac{6}{25}$	952	$\frac{119}{200}$		$9\frac{13}{25}$
30	930	$\frac{93}{160}$		$9\frac{3}{10}$	960	$\frac{3}{5}$		$9\frac{3}{5}$	990	$\frac{99}{160}$		$9\frac{9}{10}$	1020	$\frac{51}{80}$		$10\frac{1}{5}$
32	992	$\frac{31}{50}$		$9\frac{23}{25}$	1024	$\frac{16}{25}$		$10\frac{6}{25}$	1056	$\frac{33}{50}$		$10\frac{14}{25}$	1088	$\frac{17}{25}$		$10\frac{22}{25}$
35	1085	$\frac{217}{320}$		$10\frac{17}{20}$	1120	$\frac{7}{10}$		$11\frac{1}{5}$	1155	$\frac{231}{320}$		$11\frac{11}{20}$	1190	$\frac{119}{160}$		$11\frac{9}{10}$
36	1116	$\frac{279}{400}$		$11\frac{4}{25}$	1152	$\frac{18}{25}$		$11\frac{13}{25}$	1188	$\frac{297}{400}$		$11\frac{22}{25}$	1224	$\frac{153}{200}$		$12\frac{6}{25}$
40	1240	$\frac{31}{40}$		$12\frac{2}{5}$	1280	$\frac{4}{5}$		$12\frac{4}{5}$	1320	$\frac{33}{40}$		$13\frac{1}{5}$	1360	$\frac{17}{20}$		$13\frac{3}{5}$
44	1364	$\frac{341}{400}$		$13\frac{16}{25}$	1408	$\frac{22}{25}$		$14\frac{2}{25}$	1452	$\frac{363}{400}$		$14\frac{13}{25}$	1496	$\frac{187}{200}$		$14\frac{24}{25}$
45	1395	$\frac{279}{320}$		$13\frac{19}{20}$	1440	$\frac{9}{10}$		$14\frac{2}{5}$	1485	$\frac{297}{320}$		$14\frac{17}{20}$	1530	$\frac{153}{100}$		$15\frac{3}{10}$
48	1488	$\frac{93}{100}$		$14\frac{22}{25}$	1536	$\frac{24}{25}$		$15\frac{9}{25}$	1584	$\frac{99}{100}$		$15\frac{21}{25}$	1632	$1\frac{1}{50}$	1	$\frac{8}{25}$
50	1550	$\frac{31}{32}$		$15\frac{1}{2}$	1600	1	1		1650	$1\frac{1}{32}$	1	$\frac{1}{2}$	1700	$1\frac{1}{16}$	1	1
55	1705	$1\frac{21}{320}$	1	$1\frac{1}{20}$	1760	$1\frac{1}{10}$	1	$1\frac{3}{5}$	1815	$1\frac{43}{320}$	1	$2\frac{3}{20}$	1870	$1\frac{27}{160}$	1	$2\frac{7}{10}$
60	1860	$1\frac{13}{80}$	1	$2\frac{3}{5}$	1920	$1\frac{1}{5}$	1	$3\frac{1}{5}$	1980	$1\frac{19}{80}$	1	$3\frac{4}{5}$	2040	$1\frac{11}{40}$	1	$4\frac{2}{5}$
65	2015	$1\frac{83}{320}$	1	$4\frac{3}{20}$	2080	$1\frac{3}{10}$	1	$4\frac{4}{5}$	2145	$1\frac{109}{320}$	1	$5\frac{9}{20}$	2210	$1\frac{61}{160}$	1	$6\frac{1}{16}$
70	2170	$1\frac{57}{160}$	1	$5\frac{7}{10}$	2240	$1\frac{2}{5}$	1	$6\frac{2}{5}$	2310	$1\frac{71}{160}$	1	$7\frac{1}{10}$	2380	$1\frac{39}{80}$	1	$7\frac{4}{5}$
75	2325	$1\frac{29}{64}$	1	$7\frac{1}{4}$	2400	$1\frac{1}{2}$	1	8	2475	$1\frac{35}{46}$	1	$8\frac{3}{4}$	2550	$1\frac{19}{32}$	1	$9\frac{1}{2}$
80	2480	$1\frac{11}{20}$	1	$8\frac{4}{5}$	2560	$1\frac{3}{5}$	1	$9\frac{3}{5}$	2640	$1\frac{13}{20}$	1	$10\frac{2}{5}$	2720	$1\frac{7}{10}$	1	$11\frac{1}{5}$
85	2635	$1\frac{207}{320}$	1	$10\frac{7}{20}$	2720	$1\frac{7}{10}$	1	$11\frac{1}{5}$	2805	$1\frac{241}{320}$	1	$12\frac{1}{20}$	2890	$1\frac{129}{160}$	1	$12\frac{9}{10}$
90	2790	$1\frac{119}{160}$	1	$11\frac{9}{10}$	2880	$1\frac{4}{5}$	1	$12\frac{4}{5}$	2970	$1\frac{137}{160}$	1	$13\frac{7}{10}$	3060	$1\frac{73}{80}$	1	$14\frac{6}{10}$
95	2945	$1\frac{269}{320}$	1	$13\frac{9}{20}$	3040	$1\frac{9}{10}$	1	$14\frac{2}{5}$	3135	$1\frac{307}{320}$	1	$15\frac{7}{20}$	3230	$2\frac{3}{160}$	2	$\frac{3}{10}$
100	3100	$1\frac{15}{16}$	1	15	3200	2	2		3300	$2\frac{1}{16}$	2	1	3400	$2\frac{1}{8}$	2	2
105	3255	$2\frac{11}{320}$	2	$\frac{11}{20}$	3360	$2\frac{1}{10}$	2	$1\frac{3}{5}$	3465	$2\frac{53}{320}$	2	$2\frac{13}{20}$	3570	$2\frac{37}{160}$	2	$3\frac{7}{10}$
110	3410	$2\frac{21}{160}$	2	$2\frac{1}{10}$	3520	$2\frac{1}{5}$	2	$3\frac{1}{5}$	3630	$2\frac{43}{160}$	2	$4\frac{3}{10}$	3740	$2\frac{27}{80}$	2	$5\frac{2}{5}$
115	3565	$2\frac{73}{320}$	2	$3\frac{13}{20}$	3680	$2\frac{3}{10}$	2	$4\frac{4}{5}$	3795	$2\frac{119}{320}$	2	$5\frac{19}{20}$	3910	$2\frac{71}{160}$	2	$7\frac{1}{10}$
120	3720	$2\frac{13}{40}$	2	$5\frac{1}{5}$	3840	$2\frac{2}{5}$	2	$6\frac{2}{5}$	3960	$2\frac{19}{40}$	2	$7\frac{3}{5}$	4080	$2\frac{11}{20}$	2	$8\frac{4}{5}$
125	3875	$2\frac{27}{64}$	2	$6\frac{3}{4}$	4000	$2\frac{1}{2}$	2	8	4125	$2\frac{37}{64}$	2	$9\frac{1}{4}$	4250	$2\frac{21}{32}$	2	$10\frac{1}{2}$
130	4030	$2\frac{83}{160}$	2	$8\frac{3}{10}$	4160	$2\frac{6}{10}$	2	$9\frac{3}{5}$	4290	$2\frac{109}{160}$	2	$10\frac{9}{10}$	4420	$2\frac{61}{80}$	2	$12\frac{1}{5}$
135	4185	$2\frac{197}{320}$	2	$9\frac{17}{20}$	4320	$2\frac{7}{10}$	2	$11\frac{1}{5}$	4455	$2\frac{251}{320}$	2	$12\frac{11}{20}$	4590	$2\frac{139}{160}$	2	$13\frac{9}{10}$
140	4340	$2\frac{57}{80}$	2	$11\frac{2}{5}$	4480	$2\frac{4}{5}$	2	$12\frac{4}{5}$	4620	$2\frac{71}{80}$	2	$14\frac{1}{5}$	4760	$2\frac{39}{40}$	2	$15\frac{3}{5}$
145	4495	$2\frac{259}{320}$	2	$12\frac{19}{20}$	4640	$2\frac{9}{10}$	2	$14\frac{2}{5}$	4785	$2\frac{317}{320}$	2	$15\frac{17}{20}$	4930	$2\frac{13}{160}$	2	$1\frac{3}{10}$
150	4650	$2\frac{29}{32}$	2	$14\frac{1}{2}$	4800	3	3		4950	$3\frac{15}{160}$	3	$1\frac{1}{2}$	5100	$3\frac{3}{16}$	3	3

Table of Warp or Filling Yarn Required for One Yard of Cloth with No. 1 Yarn, in Yards, Runs, Pounds and Ounces.—For Woolen Yarn.

Th'ds per Inch.	Width of Goods, 35 Inches.				Width of Goods, 36 Inches.			
	Yards.	Runs.	Lbs.	Oz.	Yards.	Runs.	Lbs.	Oz.
20	700	$\frac{7}{16}$		7	720	$\frac{9}{20}$		$7\frac{1}{5}$
24	840	$\frac{21}{40}$		$8\frac{2}{5}$	864	$\frac{27}{50}$		$8\frac{16}{25}$
25	875	$\frac{35}{64}$		$8\frac{3}{4}$	900	$\frac{9}{16}$		9
28	980	$\frac{49}{80}$		$9\frac{4}{5}$	1008	$\frac{63}{100}$		$10\frac{2}{25}$
30	1050	$\frac{21}{32}$		$10\frac{1}{2}$	1080	$\frac{27}{40}$		$10\frac{4}{5}$
32	1120	$\frac{7}{10}$		$11\frac{1}{5}$	1152	$\frac{18}{25}$		$11\frac{13}{25}$
35	1225	$\frac{49}{64}$		$12\frac{1}{4}$	1260	$\frac{63}{80}$		$12\frac{3}{5}$
36	1260	$\frac{63}{80}$		$12\frac{3}{5}$	1296	$\frac{81}{100}$		$12\frac{24}{25}$
40	1400	$\frac{7}{8}$		14	1440	$\frac{9}{10}$		$14\frac{2}{5}$
44	1540	$\frac{77}{80}$		$15\frac{2}{5}$	1584	$\frac{99}{100}$		$15\frac{19}{25}$
45	1575	$\frac{63}{64}$		$15\frac{3}{4}$	1620	$1\frac{1}{80}$	1	$\frac{1}{5}$
48	1680	$1\frac{1}{20}$	1	$\frac{4}{5}$	1728	$1\frac{2}{25}$	1	$1\frac{7}{25}$
50	1750	$1\frac{3}{32}$	1	$1\frac{1}{2}$	1800	$1\frac{1}{8}$	1	2
55	1925	$1\frac{13}{64}$	1	$3\frac{1}{4}$	1980	$1\frac{19}{80}$	1	$3\frac{4}{5}$
60	2100	$1\frac{5}{16}$	1	5	2160	$1\frac{7}{20}$	1	$5\frac{3}{5}$
65	2275	$1\frac{27}{64}$	1	$6\frac{3}{4}$	2340	$1\frac{37}{80}$	1	$7\frac{2}{5}$
70	2450	$1\frac{17}{32}$	1	$8\frac{1}{2}$	2520	$1\frac{23}{40}$	1	$9\frac{1}{5}$
75	2625	$1\frac{41}{64}$	1	$10\frac{1}{4}$	2700	$1\frac{11}{16}$	1	11
80	2800	$1\frac{3}{4}$	1	12	2880	$1\frac{4}{5}$	1	$12\frac{4}{5}$
85	2975	$1\frac{55}{64}$	1	$13\frac{3}{4}$	3060	$1\frac{73}{80}$	1	$14\frac{3}{5}$
90	3150	$1\frac{31}{32}$	1	$15\frac{1}{2}$	3240	$2\frac{1}{40}$	2	$\frac{2}{5}$
95	3325	$1\frac{5}{64}$	1	$1\frac{1}{4}$	3420	$2\frac{11}{80}$	2	$2\frac{1}{5}$
100	3500	$2\frac{3}{16}$	2	3	3600	$2\frac{1}{4}$	2	4
105	3675	$2\frac{19}{64}$	2	$4\frac{3}{4}$	3780	$2\frac{29}{80}$	2	$5\frac{4}{5}$
110	3850	$2\frac{13}{32}$	2	$6\frac{1}{2}$	3960	$2\frac{19}{40}$	2	$7\frac{3}{5}$
115	4025	$2\frac{33}{64}$	2	$8\frac{1}{4}$	4140	$2\frac{47}{80}$	2	$9\frac{8}{20}$
120	4200	$2\frac{5}{8}$	2	10	4320	$2\frac{7}{10}$	2	$11\frac{1}{5}$
125	4375	$2\frac{47}{64}$	2	$11\frac{3}{4}$	4500	$2\frac{13}{16}$	2	13
130	4550	$2\frac{27}{32}$	2	$13\frac{1}{2}$	4680	$2\frac{37}{40}$	2	$14\frac{4}{5}$
135	4725	$2\frac{61}{64}$	2	$15\frac{1}{4}$	4860	$3\frac{3}{80}$	3	$\frac{3}{5}$
140	4900	$3\frac{1}{16}$	3	1	5040	$3\frac{3}{20}$	3	$2\frac{2}{5}$
145	5075	$3\frac{11}{64}$	3	$2\frac{3}{4}$	5220	$3\frac{21}{80}$	3	$4\frac{1}{5}$
150	5250	$3\frac{9}{32}$	3	$4\frac{1}{2}$	5400	$3\frac{6}{16}$	3	6

Th'ds per Inch.	Width of Goods, 37 Inches.				Width of Goods, 38 Inches.			
	Yards.	Runs.	Lbs.	Oz.	Yards.	Runs.	Lbs.	Oz.
20	740	$\frac{37}{80}$		$7\frac{2}{5}$	760	$\frac{19}{40}$		$7\frac{3}{5}$
24	888	$\frac{111}{200}$		$8\frac{22}{25}$	912	$\frac{57}{100}$		$9\frac{3}{25}$
25	925	$\frac{37}{64}$		$9\frac{1}{4}$	950	$\frac{19}{32}$		$9\frac{1}{2}$
28	1036	$\frac{259}{400}$		$10\frac{9}{25}$	1064	$\frac{133}{200}$		$10\frac{16}{25}$
30	1110	$\frac{111}{160}$		$11\frac{1}{10}$	1140	$\frac{57}{80}$		$11\frac{2}{5}$
32	1184	$\frac{37}{50}$		$11\frac{21}{25}$	1216	$\frac{19}{25}$		$12\frac{4}{25}$
35	1295	$\frac{259}{320}$		$12\frac{19}{20}$	1330	$\frac{133}{160}$		$13\frac{3}{10}$
36	1332	$\frac{333}{400}$		$13\frac{8}{25}$	1368	$\frac{171}{200}$		$13\frac{17}{25}$
40	1480	$\frac{37}{40}$		$14\frac{4}{5}$	1520	$\frac{19}{20}$		$15\frac{1}{5}$
44	1628	$1\frac{7}{400}$	1	$\frac{7}{25}$	1672	$1\frac{9}{200}$	1	$\frac{18}{25}$
45	1665	$1\frac{13}{320}$	1	$\frac{13}{20}$	1710	$1\frac{11}{160}$	1	$1\frac{1}{10}$
48	1776	$1\frac{11}{100}$	1	$1\frac{19}{25}$	1824	$1\frac{7}{50}$	1	$2\frac{6}{25}$
50	1850	$1\frac{5}{32}$	1	$2\frac{1}{2}$	1900	$1\frac{6}{32}$	1	3
55	2035	$1\frac{87}{320}$	1	$4\frac{7}{20}$	2090	$1\frac{49}{160}$	1	$4\frac{9}{10}$
60	2220	$1\frac{31}{80}$	1	$6\frac{1}{5}$	2280	$1\frac{17}{40}$	1	$6\frac{4}{5}$
65	2405	$1\frac{161}{320}$	1	$8\frac{1}{20}$	2470	$1\frac{87}{160}$	1	$8\frac{7}{10}$
70	2590	$1\frac{99}{160}$	1	$9\frac{9}{10}$	2660	$1\frac{53}{80}$	1	$10\frac{3}{5}$
75	2775	$1\frac{47}{64}$	1	$11\frac{3}{4}$	2850	$1\frac{25}{32}$	1	$12\frac{1}{2}$
80	2960	$1\frac{17}{20}$	1	$13\frac{3}{5}$	3040	$1\frac{9}{10}$	1	$14\frac{2}{5}$
85	3145	$1\frac{309}{320}$	1	$15\frac{9}{20}$	3230	$2\frac{3}{160}$	2	$\frac{3}{10}$
90	3330	$2\frac{13}{160}$	2	$1\frac{3}{10}$	3420	$2\frac{11}{80}$	2	$2\frac{1}{5}$
95	3515	$2\frac{63}{320}$	2	$3\frac{3}{20}$	3610	$2\frac{41}{160}$	2	$4\frac{1}{10}$
100	3700	$2\frac{5}{16}$	2	5	3800	$2\frac{3}{8}$	2	6
105	3885	$2\frac{137}{320}$	2	$6\frac{17}{20}$	3990	$2\frac{79}{160}$	2	$7\frac{9}{10}$
110	4070	$2\frac{87}{160}$	2	$8\frac{7}{10}$	4180	$2\frac{49}{80}$	2	$9\frac{4}{5}$
115	4255	$2\frac{211}{320}$	2	$10\frac{11}{20}$	4370	$2\frac{117}{160}$	2	$11\frac{14}{20}$
120	4440	$2\frac{31}{40}$	2	$12\frac{2}{5}$	4560	$2\frac{17}{20}$	2	$13\frac{3}{5}$
125	4625	$2\frac{57}{64}$		$14\frac{1}{4}$	4750	$2\frac{31}{32}$	2	$15\frac{1}{2}$
130	4810	$3\frac{1}{160}$	3	$\frac{1}{10}$	4940	$3\frac{7}{80}$	3	$1\frac{2}{5}$
135	4995	$3\frac{39}{320}$	2	$1\frac{19}{20}$	5130	$3\frac{33}{160}$	3	$3\frac{3}{10}$
140	5180	$3\frac{19}{80}$	3	$3\frac{4}{5}$	5320	$3\frac{13}{40}$	3	$5\frac{1}{5}$
145	5365	$3\frac{113}{320}$	3	$5\frac{13}{20}$	5510	$3\frac{71}{160}$	3	$7\frac{1}{10}$
150	5550	$3\frac{15}{32}$	3	$7\frac{1}{2}$	5700	$3\frac{9}{16}$	3	9

Tab of Warp or Filling Yarn Required to Make One Yard of Cloth with No. 1 Yarn, in Yards, Runs, Pounds and Ounces.—For Woolen Yarn.

Th'd per Inch	Width of Goods, 39 Inches.				Width of Goods, 40 Inches.				Width of Goods, 41 Inches.				Width of Goods, 42 Inches.			
	Yards.	Runs.	Lbs.	Oz.	Yards.	Runs.	Lbs.	Oz.	Yards.	Runs.	Lbs.	Oz.	Yards.	Runs.	Lbs.	Oz.
20	780	39/80		7 4/5	800	1/2		8	820	41/80		8 1/5	840	21/40		8 2/5
24	936	117/200		9 9/25	960	3/5		9 3/5	984	123/200		9 21/25	1008	63/100		10 2/25
25	975	39/64		9 3/4	1000	5/8		10	1025	41/64		10 1/4	1050	21/32		10 1/2
28	1092	273/400		10 23/25	1120	7/10		11 1/5	1148	287/400		11 12/25	1176	147/200		11 19/25
30	1170	117/160		11 7/10	1200	3/4		12	1230	123/160		12 3/10	1260	63/80		12 3/5
32	1248	39/50		12 12/25	1280	4/5		12 4/5	1312	41/50		13 3/25	1344	21/25		13 11/25
35	1365	273/320		13 13/20	1400	7/8		14	1435	287/320		14 7/20	1470	147/160		14 7/10
36	1404	351/400		14 1/25	1440	9/10		14 2/5	1476	369/400		14 19/25	1512	189/200		15 3/25
40	1560	39/40		15 3/5	1600	1	1		1640	1 1/40	1	2/5	1680	1 1/20	1	4/5
44	1716	1 29/400	1	1 4/25	1760	1 1/10	1	1 3/5	1804	1 51/400	1	2 1/25	1848	1 31/200	1	2 12/25
45	1755	1 31/320	1	1 11/20	1800	1 1/8	1	2	1845	1 49/320	1	2 9/20	1890	1 29/160	1	2 9/10
48	1872	1 17/100	1	2 18/25	1920	1 1/5	1	3 1/5	1968	1 23/100	1	3 17/25	2016	1 13/50	1	4 4/25
50	1950	1 7/32	1	3 1/2	2000	1 1/4	1	4	2050	1 9/32	1	4 1/2	2100	1 10/32	1	5
55	2145	1 109/320	1	5 9/20	2200	1 3/8	1	6	2255	1 131/320	1	6 11/20	2310	1 71/160	1	7 1/10
60	2340	1 37/80	1	7 2/5	2400	1 1/2	1	8	2460	1 43/80	1	8 3/5	2520	1 23/40	1	9 1/5
65	2535	1 187/320	1	9 7/20	2600	1 5/8	1	10	2665	1 213/320	1	10 13/20	2730	1 113/160	1	11 3/10
70	2730	1 113/160	1	11 3/10	2800	1 3/4	1	12	2870	1 127/160	1	12 7/10	2940	1 67/80	1	13 2/5
75	2925	1 53/64	1	13 1/4	3000	1 14/16	1	14	3075	1 59/64	1	14 3/4	3150	1 31/32	1	15 1/2
80	3120	1 19/20	1	15 1/5	3200	2	2		3280	2 1/20	2	4/5	3360	2 1/10	2	1 3/5
85	3315	2 23/320	2	1 3/20	3400	2 1/8	2	2	3485	2 57/320	2	2 17/20	3570	2 37/160	2	3 7/10
90	3510	2 31/160	2	3 1/10	3600	2 1/4	2	4	3690	2 49/160	2	4 9/10	3780	2 29/80	2	5 4/5
95	3705	2 101/320	2	5 1/20	3800	2 3/8	2	6	3895	2 139/320	2	6 19/20	3990	2 79/160	2	7 9/10
100	3900	2 7/16	2	7	4000	2 1/2	2	8	4100	2 9/16	2	9	4200	2 5/8	2	10
105	4095	2 179/320	2	8 19/20	4200	2 5/8	2	10	4305	2 221/320	2	11 1/20	4410	2 121/160	2	12 1/10
110	4290	2 109/160	2	10 9/10	4400	2 3/4	2	12	4510	2 131/160	2	13 1/10	4620	2 71/80	2	14 1/5
115	4485	2 257/320	2	12 17/20	4600	2 7/8	2	14	4715	2 303/320	2	15 3/20	4830	3 3/160	3	3/10
120	4680	2 37/40	2	14 4/5	4800	3	3		4920	3 3/40	3	1 1/5	5040	3 3/20	3	2 2/5
125	4875	3 3/64	3	3/4	5000	3 1/8	3	2	5125	3 13/64	3	3 1/4	5250	3 9/32	3	4 1/2
130	5070	3 27/160	3	2 7/10	5200	3 1/4	3	4	5330	3 53/160	3	5 3/10	5460	3 33/80	3	6 3/5
135	5265	3 93/320	3	4 13/20	5400	3 6/16	3	6	5535	3 147/320	3	7 7/20	5670	3 87/160	3	8 7/10
140	5460	3 33/80	3	6 3/5	5600	3 1/2	3	8	5740	3 47/80	3	9 2/5	5880	3 27/40	3	10 4/5
145	5655	3 171/320	3	8 11/20	5800	3 5/8	3	10	5945	3 229/320	3	11 9/20	6090	3	3	12 9/10
150	5850	3 21/32	3	10 1/2	6000	3 3/4	3	12	6150	3 27/32	3	13 1/2	6300	3 15/16	3	15

EXPLANATION OF THE TABLES.

Loom Table.—On pages 142 and 143 there is a Loom Table, most convenient for all manner of calculations relative to the product of looms. The quantity of goods given in this table being *the greatest possible product* for a loom running ten hours without stopping, it will be necessary always to include in all calculations a due allowance for stoppage, which is unavoidable. This varies according to the work, from 20 to 50 per cent. for good work; while for bad work, such as will cause many extra stoppages, one must sometimes allow from 40 to 70 per cent. Some judgment is here needed. The table will afford every manufacturer a source of profit, if he will compare the actual product of each loom with the greatest possible product, at stated times, say weekly. Thus he will ascertain when and where unnecessary stoppages occur, and managers may thus produce the best results as regards product.

Reed Tables.—On page 141 may be found a Reed Table, which gives at once all the particulars of a reed, excepting the total number of threads per warp.

This table is especially useful where a certain fabric is reproduced, only a small sample being at hand upon which to base calculations. The threads per inch being known, the total number of threads, also the width of the warp in the reed, are easily found in the tables on pages 49, 50, 51, 52, of the Appendix.

Yarn Table.—One of the most important Yarn Tables to be found is that on page 48 of the Appendix, where the common methods of numbering yarn in this country are so exhibited as to afford a convenient means of making quick and accurate comparisons between them all, or in other words, of finding the equivalent of either system in all the others.

On pages 53, 54 and 55 of the Appendix are the *Tables showing the Weight of One Hundred Yards of Warp Yarn in Pounds and Ounces*, for warps of one thread to warps of ten thousand threads. This table was based upon one hundred yards to avoid small fractions, which cause inaccuracies, some being necessarily dropped,

while others must be retained at a great inconvenience. To find the desired quantity for less than one hundred yards is very simple, as the fractions are decimals, and to divide by 100 one has only to move the decimal point. On page 56 is a table similar to the above mentioned, but it is intended for calculations of the filling. In this the weight given being for one yard of cloth only, it is self-evident that for more yards the multiplication of the full number of yards by the weight of yarn in one yard, will give the desired result. Also, as the table is all for No. 1 yarn, having found the quantity that would be necessary if No. 1 yarn were used, this quantity must be divided by the actual yarn number, to ascertain the quantity necessary of that size of yarn — excepting grain numbers of woolen yarn, which are in inverse ratio to the basis, or unit, No. 1 yarn.

By the use of this table the number of calculations for ascertaining the amount of filling yarn in any quantity of cloth, are reduced to two.

For yet other calculations of a similar nature, there are four tables for each, woolen, cotton and worsted; all so clear and convenient as to need no explanation, except to those who have never seen the tables.

The threads per inch and the width of the goods being known, this table will show at once the quantity of yarn in one yard of the goods, in yards, hanks or runs, and in pounds and ounces, alike for warp or filling.

Being in sets for cotton, woolen and worsted, they also serve to show the difference in the yarns required for the same number of threads in the different materials.

All told, these tables aid the inexperienced in making intricate calculations easy; they save labor for all, since by using them several calculations are avoided in every instance. They also serve as most excellent means of comparison.

CONTENTS OF APPENDIX.

OPINIONS OF THE PRESS.

A Manual for Designers, Managers, Weavers, and all Others Connected with the Manufacture of Textile Fabrics. By Alfred Spitzli. A. & A. F. Spitzli, publishers, West Troy, N. Y. 1881. Price in paper, $1 ; cloth, $2.

This is an elegantly printed book of nearly two hundred pages, large 8vo., tinted paper, and contains an amount of practical information which is modern and useful. The subjects are arranged in the style of a cyclopedia, in alphabetical order, and many of them are in themselves able and comprehensive articles. The subjects treated upon are directly connected with the textile manufacturing interests. The articles upon draughting patterns for fancy goods are the clearest of anything we have ever seen, and directions of a separate nature are given in many places, and it is a book that will be of real value to any one who is interested especially in the manufacture of fancy goods, whether made of cotton, wool or mixed stock.—*Boston Journal of Commerce.*

Spitzli's Manual and Illustrated Catalogue of Instruments and Accessories for those Connected with the Manufacture of Textile Fabrics. Second Edition. A. & A. F. Spitzli, publishers, West Troy, N. Y. 1881.

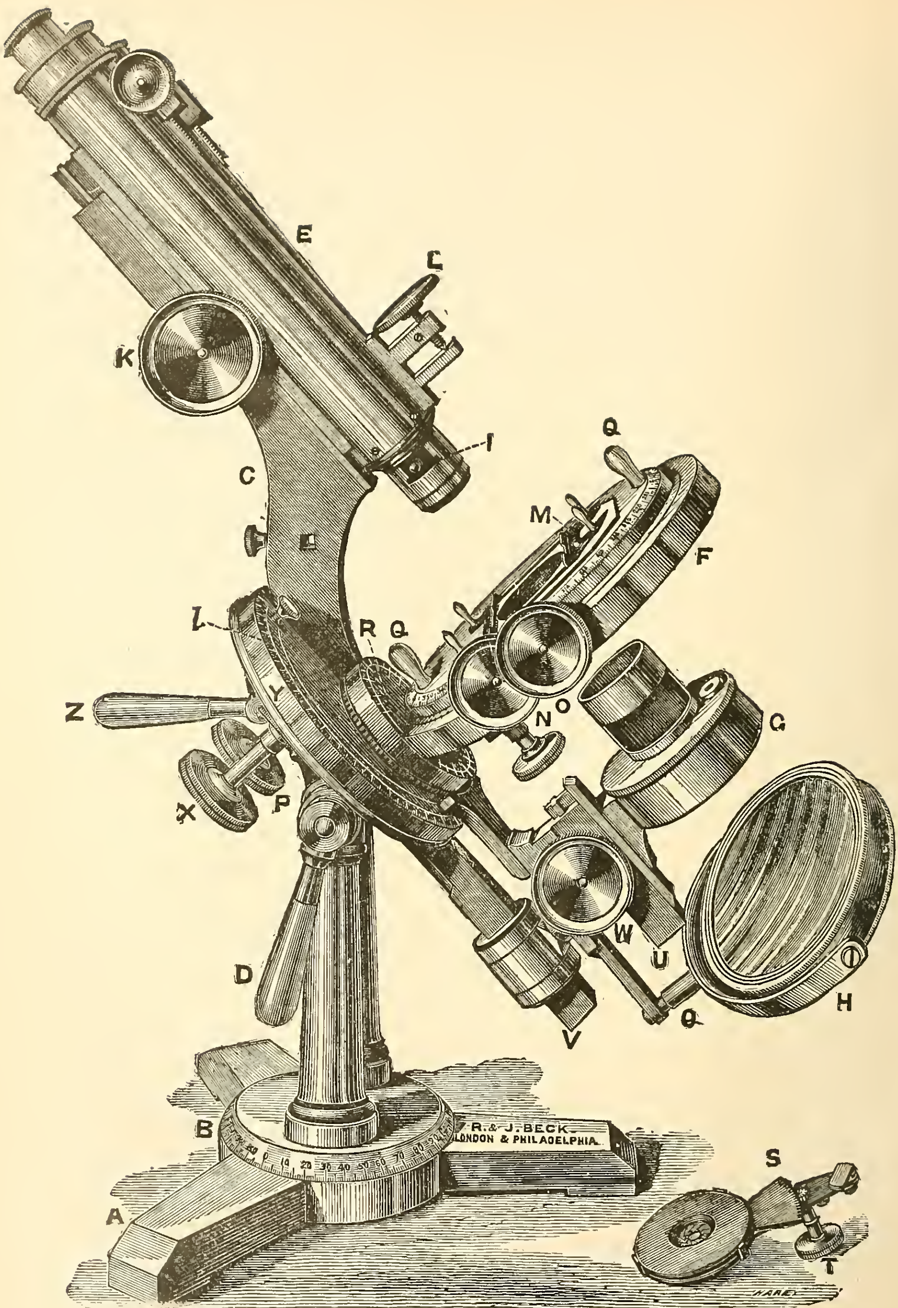
This book, of which we made casual mention a few weeks since, has now been issued from the press complete, and our further acquaintance with it is very pleasant as well as instructive. Its suggestions to beginners contain some very condensed common sense. The body of the Manual is of the encyclopedia form or arrangement, and the author has very sensibly stripped it of everything technical, so far as he could. The items are many articles complete in themselves. The Sorting of Stock, Balance of Cloth, and many similar matters are quite extensively treated. Backing Fabrics is illustrated by pattern drafts. Boilers are extensively treated, and with a great many directions that are useful. Dye Woods, Drugs, Calculations, Recipes, are all carried through the body of the work. The articles on Color and Cross Drawing are particularly commendable. Many of the articles in this book are treatises in themselves, while the directions for dissecting and getting up patterns are the clearest and cleanest we have ever seen printed. A reed table and other useful tables are embodied in the work. It treats of cotton, wool, worsted and other matters to the extent of one hundred and eighty pages, and has also embodied with it a catalogue of instruments, stationery, and books for designers and others, together with a great many incidental matters very desirable, and is one of the best works published. The prices range from one to two dollars, according to binding. Address P. O. Box 530, West Troy, N. Y.—*Boston Journal of Commerce.*

Messrs. A. & A. F. Spitzli having advertised their Manual extensively in advance of its publication, have been overwhelmed with orders, and are very much mortified by their inability to fill them promptly in consequence of the failure of their printers to issue the book with the promptness they had promised. We are in receipt of sample pages of the work, which clearly indicate the great value of the completed book. The Messrs. Spitzli are pressing the work as rapidly as possible.—*The Manufacturers' Review and Industrial Record.*

Spitzli's Manual and Illustrated Catalogue. A Catalogue of Instruments, Accessories, Stationery, and Books for Managers, Weavers, and all others in any way connected with the Manufacture of Textile Fabrics.

This valuable Manual is issued in a second edition of 182 pages, and 118 pages of Catalogue proper. The most interesting part of this publication is the condensed description which is given of the several processes required in actual manufacture through the entire list of fabrics. A descriptive list of all the appliances of manufacture is also given, and the whole forms an excellent work of reference for all engaged in textile industries.—*The Textile Record of America.*

We have just received Spitzli's Manual and Illustrated Catalogue, and find it to contain a great amount of practical information on all branches of textile manufacture. Although the author is eminently qualified by practical personal experience to write a work of the kind, we are glad to find the work not confined to one man's knowledge, but constantly quoting the highest authorities on the subjects treated, and forming a condensed encyclopedia of technical definitions, tables, processes, receipts, illustrations, designs, etc., connected with the manufacture of textile goods.—*The Textile.*



(ONE-THIRD ACTUAL SIZE.)

The "International" Improved Large Best Microscope Stand. *See* PAGE 9.

AN ILLUSTRATED CATALOGUE

OF

INSTRUMENTS,

ACCESSORY APPARATUS,

STATIONERY AND BOOKS,

FOR

DESIGNERS AND OTHERS,

ENGAGED IN THE MANUFACTURE OF

TEXTILE FABRICS.

A. & A. F. SPITZLI,

P. O. BOX 530,

WEST TROY, N. Y.

TROY, N. Y.:
WM. H. YOUNG, 8 & 9 FIRST STREET,
1881.

NOTICE.

The prices in this Catalogue are adhered to as nearly as possible, but owing to frequent fluctuations in the value of many articles, alterations may be necessary from time to to time.

In ordering, give the number with price of the article.

TERMS CASH, at the prices stated. *Discounts cannot be given excepting on large orders, and to Dealers, Colleges and Schools.* A large order means many articles, not always a large sum.

When the party ordering goods is unknown to us, the money should accompany the order, either by bank draft or postal money order. *Money should never be sent through the mails.*

If money or checks are sent by mail the letters should be registered.

Where, however, this is not done goods will be sent C. O. D., provided a remittance accompanies the order to insure the prompt taking up of the package on receipt.

The express company's charges for collecting and returning money on C. O. D. bills must be paid by the party ordering the goods.

Small articles may be sent by mail in open packages at one cent per ounce. Pointed tools and glassware have to pay full letter rates, six cents per ounce. Liquids cannot be sent by mail.

Articles of Glass, such as Spectacles, Eye-glasses and Microscope Slides, can now be sent by mail at *Merchandise Rates*, but only in metallic boxes, as approved by the department. These will be furnished *at cost*, and are very cheap. Postage must be prepaid, and the necessary amount must be included in the remittance accompanying the order.

All packing boxes will be charged for at cost prices, and all goods will be packed with the utmost care; *but no responsibility* will be assumed by us for *breakage* or other *damage*, *after* a package *leaves our premises*, except upon special contract.

Such articles as are needed by a considerable number of our customers we shall endeavor to keep in store. Orders which require alterations or additions, and those for which the goods must be manufactured, we are prepared to fill with the utmost promptness, avoiding the vexatious delays formerly so common.

A. & A. F. SPITZLI.

WEST TROY, APRIL 1, 1881.

PREFACE.

The necessity of instruments thoroughly adapted to the requirements of those who are, or hope to be, entrusted with the responsibility of regulating the cost, value, character and attractions of textile fabrics, has been exceedingly great. As every advancing step of any art or science entails new and more exacting duties upon those who endeavor to keep apace, the necessity must become more and more imperative. The delay in meeting this demand has resulted in the use of many crude, inconvenient and unsatisfactory implements in great and needless variety; also a diversity of opinions and prejudices which of course will follow some to their graves. With an available supply of the needful, open to all, the more progressive will no doubt desire to be properly equipped. In a very short period the uncouth and imperfect instruments must give place to the neat and complete, in response to the demands of science and employers. Indeed to-day the successful applicant who brings to his new position a really complete outfit, and can show by their condition, manner of using and keeping them, that he is a workman of the higher order, at once commands respect and confidence not easily dissipated.

In publishing this catalogue we do not aim to advertise a confusing profusion; on the contrary our selections of instruments, etc., have been conducted from a practical standpoint, although covering an enormous field of inquiry. At present we desire to furnish only the simplest and best articles applicable to the many varieties of work, avoiding all that is needless or objectionable. All these the catalogue enumerates in such a form that those who know their requirements may make a satisfactory selection, and that beginners and others who can not have such knowledge, may be easily and wisely aided and advised. The explanations of the instruments herein contained suffice to afford the purchaser a proper guarantee; more explicit instructions will accompany the instruments or be furnished on application. Later improvements, accessories and novelties will be published either in supplementary pages or in new editions. Any specialties not enumerated in our catalogues or so published, will be procured or manufactured by us and supplied with the greatest possible dispatch at prices to defy competition.

Inquiries are therefore always in order. We hope to gain much from new inventions which must follow the introduction of first-class instruments to so many who have never had the advantages of them, and we shall endeavor to render every aid and encouragement to inventors of improvements which we deem a decided advantage to any number of our customers, to the uttermost extent permissible by a trade distinctly in specialties which are required by such a limited number.

To select suitable outfits with fixed prices, for the many kinds of work to be provided for, would entail a loss to our customers or ourselves and prove unsatisfactory; yet when a purchaser orders a large number of smaller articles upon which the margin is greater in proportion to the price than of larger ones, we wish to make an adequate allowance similar to that made by those who are enabled to select sets or outfits suitable to their customers' wants. Our outfit reduction is certainly liberal and intended to afford the liberty to order just what is needed. If too liberal we shall soon discover it, and correct the failing; but only when absolutely obliged to, for we shall make strenuous effort to make as few changes as possible; also to serve our patrons in a just and liberal manner, hoping in these and every other particular to give perfect satisfaction.

INTRODUCTION.

Designers who are fortunate enough to need no optical aid in dissecting a pattern should not pass us by or peruse these pages thinking they were prepared for others ; they will find many things enumerated which they constantly need. The best course by far even in regard to optical instruments is to provide them before the emergency compels it. By so doing the eyes are preserved in their full strength much longer, and a familiarity with instruments is attained before they become an absolute necessity. Dissecting the pattern is by no means dissecting in its entirety, which fact is our reason for asserting that no designer and no textile factory should be without a microscope and many of the accessories thereto.

Of the drawing materials, stationery and books, sufficient remarks precede the respective lists ; we would in this place add only one more suggestion to amateurs. The possession of a complete outfit should be a beginner's first ambition. In procuring it he should be governed by two facts, viz.: expensive ornamentation is unnecessary, but the possession of implements which reflect credit upon the owner's taste and judgment are an advantage to every workman.

OUTFITS.

Almost every mail brings inquiries about outfits.

"What kind of outfits do you furnish?"

"How much does a good outfit cost?"

"Do you take pay by installments?"

We answer: Our outfits consist of Instruments, Books and Stationery, in collections selected from our catalogue by the purchaser or ourselves. It is impossible to select beforehand outfits for the many branches in which our goods are required without injustice to our patrons and ourselves, therefore Designers, Superintendents, Overseers or Learners may select their outfits to suit their needs, or entrust the selection to us (in which case we need full particulars of the kind of work to be done with the instruments, &c., &c.) In either case if the selection will permit, we make the price for the whole 5 to 15 per cent. less than the sum of the separate catalogue prices.

When we are entrusted with the selection we shall take great pains to send only such articles as are necessary, unless otherwise instructed, and in no case will we send goods the value of which exceeds the remittance received.

As regards installments, we would now answer that we shall take orders from parties who do not wish to pay all at once, but with the understanding that our business and our profits are such that we can not send goods and collect afterwards. A retainer of 10 per cent. of the sum to be expended on an outfit must be sent with the order. This retainer will be kept until the last payment has been made, at which time we will deliver for the last payment, for the retainer and for the regular reduction (the same as that made to cash customers on outfits). Not less than $5.00 will be taken as a single payment, excepting the last, which is to be equal to the balance due. Not less than $2.00 will be accepted as a retainer, although the price of the outfit wanted be less than $20.00.

To aid beginners in selecting outfits, we give below an enumeration of the principal parts of a complete outfit, to be used as a guide in ordering; we have numbered it, as well as the parts, but omitted Catalogue numbers, which should always be given in ordering.

OUTFIT NO. 1.

PART I.	A COMPOUND ACHROMATIC MICROSCOPE for the examination of fibers and microscopic particles. The Binocular Economic Microscope, No. 102, with the best assortment of accessories............	$ 85 00
II.	A SINGLE DISSECTING MICROSCOPE, No. 152, with all the latest devices to make it *The* Dissecting Microscope for designers.......	25 00
III.	A FINE SCALE IN A GLASS CASE to keep it free from dust and the consequent injuries to the appearance and accuracy..............	12 00
	A SET OF WEIGHTS, including Apothecaries, Avordupois, Troy, Gram and Grain Weights....................................	8 00
IV.	TWO DIES FOR CUTTING SAMPLES to exact measure for test weighing..	7 00
V.	A TWIST COUNTER for ascertaining the amount of twist in any sample of yarn...	10 00
VI.	A SIMPLE COLLECTION OF CHEMICAL APPARATUS, adequate for all necessary tests..	18 50

VII.	TWO LINEN PROVERS, one $\frac{1}{4}$x$\frac{1}{2}$ inch and one 1 inch............	5 00
VIII.	A SET OF DISSECTING NEEDLES, Scissors, Forceps, Brush, &c., &c. In elegant case....................................	8 00
IX.	A SIMPLE, BUT EFFICIENT SET OF DRAUGHTING TOOLS. In case.	15 00
X.	A FIRST-CLASS LAMP, with condensers and necessary accessories to make dissecting patterns at night practical without destroying the eyes...	20 00
XI.	A COMPLETE ASSORTMENT OF PENS, including all kinds used by designers in general; several varieties of Common Steel Pens, Shading, Drawing, Lettering and Ruling Pens.....................	10 00
XII.	SIX COLORS OF INDELIBLE DRAWING INKS.....................	2 50
XIII.	A BOX OF CRAYONS IN 12 COLORS...........................	2 50
XIV.	AN ASSORTMENT OF LEAD PENCILS for common use and for designing..	3 00
XV.	A COMPLETE ASSORTMENT OF DESIGN PAPER, 5 quires in 6 kinds,	2 50
XVI.	A CHEAP SCRAP BOOK, to serve as a receptacle of samples picked up here and there, to be dissected and subsequently put in a better book..	3 00
XVII.	A FIRST-CLASS PATTERN BOOK for samples of goods manufactured under personal supervision....................................	6 00
XVIII.	A FIRST-CLASS PATTERN BOOK for samples of goods made by others, which have been dissected............................	6 00
XIX.	A DESIGN BOOK for use at mill................................	6 00
XX.	A DESIGN BOOK for designs gotten from dissected samples	6 00
XXI.	A COLOR BOOK in which to keep specimens of colors taken from samples or otherwise procured. Space for receipts beside each sample and a "mat" leaf over all	10 00

Few young men keep such a book, and yet in a few years one of inestimable value can be gotten together.

XXII.	TWO RECORD BOOKS, one for a record of general facts pertaining to manufacturing; one strictly for patterns or the memorandums they call for (convenient reference marks to be used)............	3 00
XXIII.	A MANUAL FOR DESIGNERS..................................	2 00
XXIV.	SOME OTHER STANDARD WORK ON WEAVING.................	10 00
	Total..	$285 50
	Reduction..	35 50
	Price of this Complete Outfit..................................	$250 00

It must not be understood that we claim this to be the only complete outfit, or that we confine anyone to it. It will, however, serve as a guide to some. For instance, instead of a Compound Microscope for $85.00 and a Single Microscope for $25.00, an instrument which will serve for both purposes can be furnished for $40.00 to $50.00, according to the accessories taken with it. Again some of these parts may already be supplied in part or entire, or may not be needed at all, in which case another saving can be effected.

OPTICAL INSTRUMENTS.

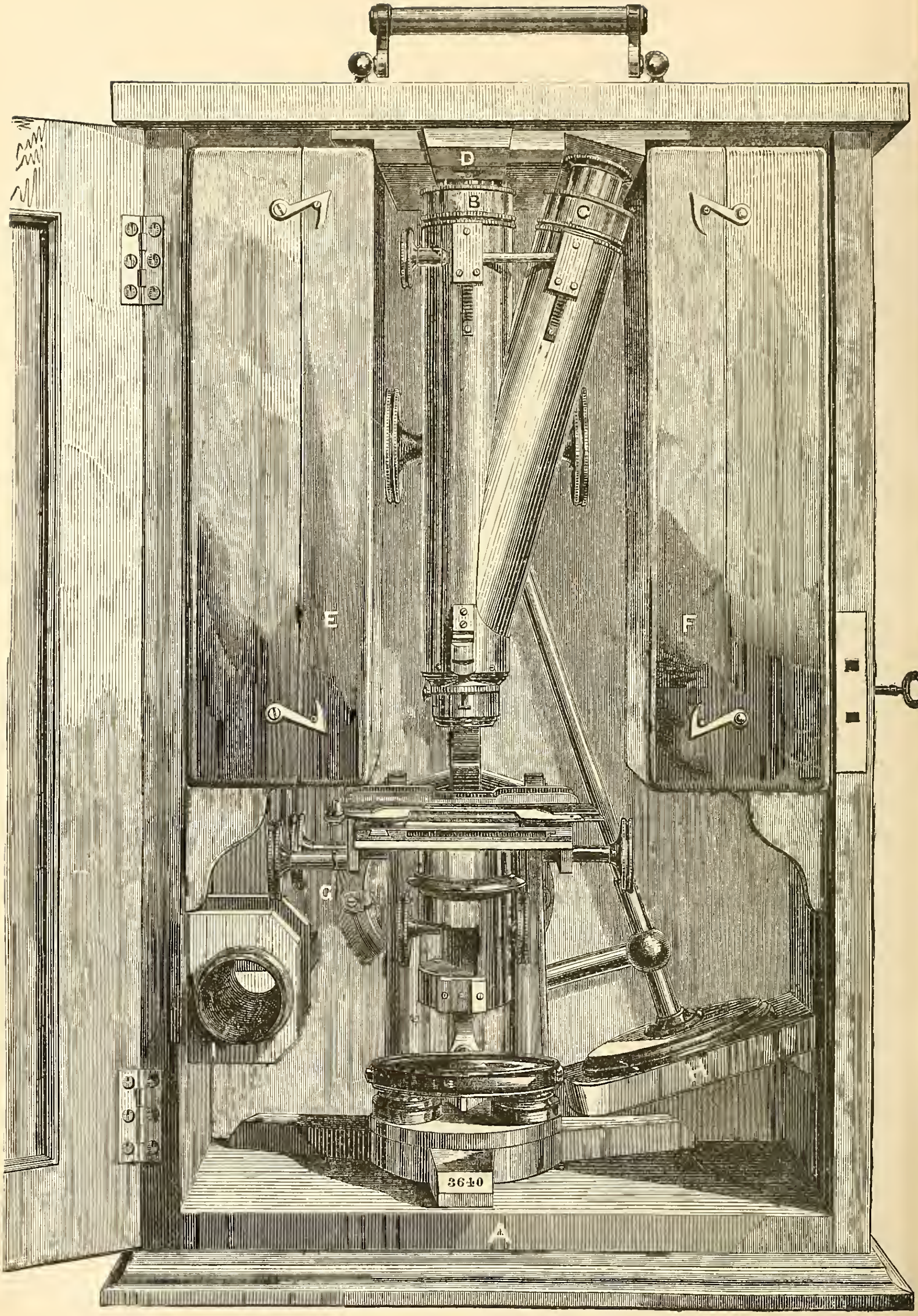
We are prepared to furnish almost any kind of Optical Instruments, as our connections afford us the very best advantages, and we will do so to accommodate our customers at any time. But for the present we intend to confine our energy entirely to the development of instruments required by the textile interests, trusting to meet with such success that additional branches in the future will not detract from the benefits we hope to extend to our present class of patrons. For the same reason do we omit in this catalogue the microscopes of the highest order, except to mention here that we will furnish at makers' prices any instrument from the one represented upon the frontispiece of this work down to those which have been selected as being much lower in price and still sufficiently nice in detail to meet any ordinary factory requirements. Our Instruments are purchased from the most reliable manufacturers when not made by ourselves, and we feel that we are justified in claiming that they are the best that can be procured for the prices herein published. Should the market values change materially before we can issue our next edition, the change will not be made in our prices without notice to the purchaser.

"The International" Improved Large Best Microscope Stand.

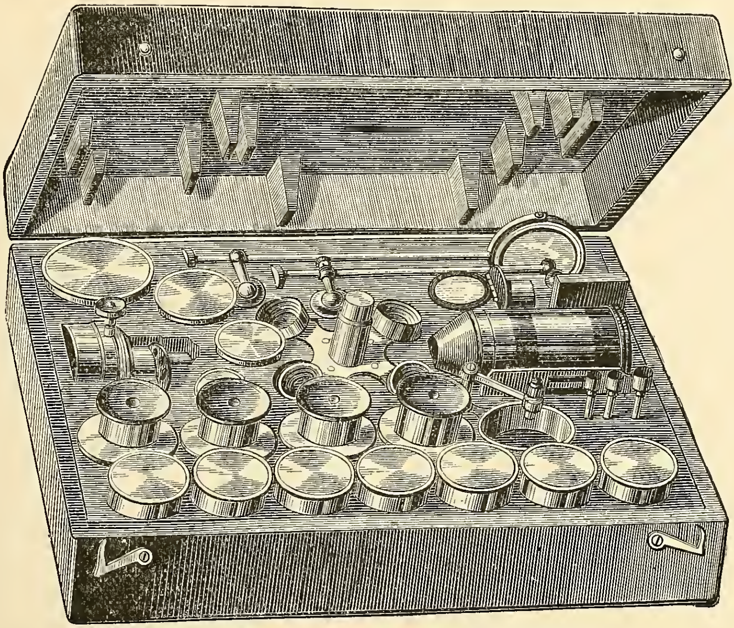
(*See* FRONTISPIECE.)

PRICE $325.00. WITH ALL THE LATEST ADDITIONS, COMPLETE, $1,600.00.

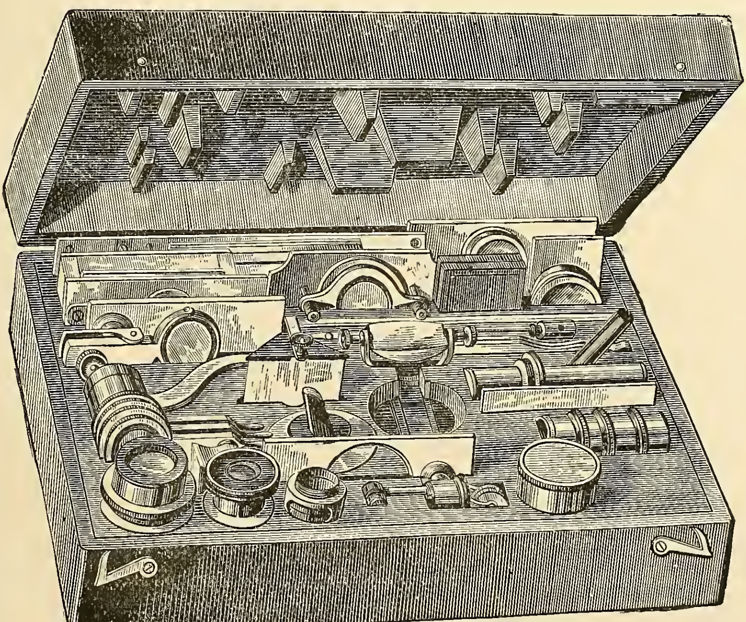
In these Instruments the Stands, the Object-Glasses, the Illuminating, and all accessory apparatus are carried to the highest possible perfection.



MODE OF PACKING FIRST-CLASS MICROSCOPES AND APPARATUS.



Mode of Packing First-Class Accessories.



Mode of Packing First-Class Accessories.

THE ECONOMIC MICROSCOPE.

The Microscope is now such an absolute necessity for the Designer, to enable him satisfactorily to carry on his investigations, that it is more than ever incumbent on the optician to construct a sound economic instrument, adapted to the special requirements of this large and increasing class.

For ordinary investigations, many of the delicate adjuncts applied to the higher priced instruments are unnecessary, and tend rather to confuse than to assist the beginner.

A firm Stand and well corrected Object-glasses are, however, indispensable; and, with a view to meet this want, we now introduce to the special attention of designers the "ECONOMIC MICROSCOPE."

The description following will fully explain both the construction and the mode of using this instrument, while the scale of prices at the conclusion will, we trust, convince all who peruse them that we are able to offer those who do not desire to spend a large sum on a microscope, an instrument thoroughly adapted to their necessities, at a very moderate outlay.

A *Compound Achromatic Microscope* consists essentially of two parts—an *Object-glass* and an *Eyepiece*—so called because they are respectively near the object and the eye when the instrument is in use. The object-glass screws, and the eyepiece slides, into opposite ends of a tube termed the *Body*, and upon the union of the two the magnifying power depends. The *Microscope Stand* is an arrangement for carrying the body, and is combined with a *Stage* for holding or giving traverse to an object, and a *Mirror* or some other provision for illumination.

The *Stand* of the ECONOMIC MICROSCOPE is made in two forms—the one with a *sliding coarse adjustment* for focussing the object, and the other where the *quick movement* is produced by a rack and pinion. On both stands the fine adjustment is given by means of a milled head at the top of the stem. The Object-glasses are attached to the stand with the Universal or Society Screw.

DESCRIPTION OF THE STAND (NO. 99) AND APPARATUS AS SUPPLIED FOR $40.00.

The foundation of the stand (No. 99) is a heavy horse-shoe base, at the bend of which is a firm pillar, having at its top a hinge joint, which allows the body to be inclined at any angle, and is sufficiently firm to permit of its being placed horizontal for use with the Camera Lucida.

At this price the instrument includes one *Eyepiece* and two *Object-glasses*, called the 1-inch and ¼-inch, from their magnifying power being nearly the same as single lenses of such focal lengths, a condensing lens for the illumination of opaque objects, a glass plate with ledge, for examination of fluids, and a pair of brass pliers. The whole packed in a neat Mahogany case, with lock and key.

Its *Linear Magnifying powers* are nearly as under:

	Draw-tube closed.	Draw-tube pulled out.
1-inch........	63	93
¼-inch........	200	290

The Body is supplied with a draw, or lengthening tube, which must be pulled out to give the full power to the object-glass.

The *Quick-focussing movement* is produced by sliding the body up and down in the tube, and the *slow motion* is given by the tube sliding over the inner stem with a spring inside, and adjusted by the milled head.

The *Stage*, upon which the object is placed, has two springs, the pins attached to which may be inserted in any of the four holes on the stage, and by their pressure (which can be varied by pushing them more or less down) they will hold the object under them or allow it to be moved about with the greatest accuracy.

The *Mirror*, besides swinging in the rotating semicircle is attached to a bar, with a joint at each end allowing a lateral movement, so as to throw oblique light on the object; and for this purpose the tube beneath the stage, carrying the Diaphragm, is attached by bayonet catches, and can be instantly removed, leaving a clear and very thin stage, allowing the utmost obliquity of illumination. This tube also carries the Polariscope, etc., etc.

The *Diaphragm* slides in the substage-fitting, and consists of a tube containing two caps, furnishing two sizes of openings immediately in contact with the under surface of the slide to be examined, and also completely cutting off all light from the mirror when opaque objects are to be viewed.

DIRECTIONS FOR USE.

To adjust the focus of the Object-glass—

In No. 99, for the quick adjustment, slide the tube up or down in the fitting. If a slight *spiral movement* is given to the tube by the finger and thumb, the motion may be made very gradual.

In No. 100 the same adjustment is made by turning the milled head backward or forward.

In both, turning the milled head gives the slow or fine adjustment.

The *light* (which for transparent objects is reflected from the mirror, and for opaque objects is condensed by means of the lens,) should, in general, be upon the left of the observer if the microscope body is inclined, but in front if the Instrument is used in a vertical position. The best is that from a white cloud on a bright day ; but a very satisfactory effect can be produced by means of a petroleum oil or gas lamp, provided it is placed not more than 10 or 12 inches from the Instrument.

For the examination of minute striæ, *side light* is necessary ; for this purpose the Mirror must be used obliquely, the diaphragm with its fitting removed, which will then allow the light to impinge on the object at a sufficiently *oblique* angle.

With the 1-inch Object-glass the light is generally in excess, and has to be lessened by means of the diaghragm fitting under the stage ; this can be slid up and down, thereby increasing or decreasing the cone of admitted rays of light.

To illuminate *opaque objects* the light is thrown upon them from above. A small condensing lens, fitting into the stage, is used for this purpose ; its focus for a lamp or candle, 4 inches from it, is about 3 inches ; for daylight, 2 inches. A large object can be placed upon the stage, but small ones are generally either laid on a slip of glass or held in the forceps. When viewing opaque objects, the diaphragm should be placed in position and the solid cap attached, so as to exclude all light from below the stage.

A glass plate, with a ledge and some pieces of thin glass, are applicable for many purposes, but are specially intended for *objects in fluid*. Thus a drop is placed upon the plate and covered by a piece of thin glass, or, the object being put upon the plate and the thin glass over it, the fluid is applied near one side and runs under by capillary attraction.

Glass of any kind requires occasional *cleaning*; a piece of soft wash-leather is the best for the purpose.

The fronts of the *Object-glasses* may be carefully wiped; but if they require anything more, it must be done by the makers.

When cleaning the *Eye-pieces*, which should be done *frequently*, the cells containing the glasses must be unscrewed, and replaced one at a time, so that they may not be mixed.

Any dirt upon the *Eye-pieces* may be detected by turning them round whilst looking through the Instrument; but if the *Object-glasses* are not clean, or are injured, it will for the most part only be seen by the object appearing misty.

The whole or any part of the extra apparatus described in the following pages may be added to the instrument at any time, without its being sent back to the makers.

ADDITIONAL APPARATUS.

Although the Instrument, as already described, may be considered complete and probably sufficient for many observers, yet the following additions can be made, all of which, packed in a small tray, will fit into the case which contains the Microscope.

When the light from the concave mirror proves insufficient for any object requiring an intense transmitted light, the *Achromatic Condenser* may be employed with advantage; this slides, by its tube, into the fitting under the stage of the Instrument, in which it has to be moved up or down until the focus of its lenses falls upon the object, the light having been previously reflected in the proper direction by the mirror.

The *Illumination of Opaque Objects*, already described, must be more or less one-sided; and in most cases it is desirable that it should be so. An illumination on any or every side, however, is easily obtained, provided the object is not too large, by means of a *Lieberkuhn*. This is a silvered cup, which slides or screws upon the front of the object-glass; and light thrown upwards by the mirror will be reflected by it down upon the object; it will then be found that, by slightly varying the inclination of the mirror, every necessary alteration in the direction of the illumination can be obtained.

It is in most cases necessary, when using the Lieberkuhn, to slide a *Dark Well* under the stage to prevent any light entering the Object-glass direct from the Mirror.

Dark-Field Illumination is, to appearance, a means of seeing a transparent object as an opaque one. The principle, however, is that all the light shall be thrown under the object, but so obliquely that it can not enter the Object-glass unless interrupted by the object; this is best accomplished by *Wenham's Parabolic Reflector*.

In this Microscope, the *Parabolic Reflector* fits under the stage in the same fitting as the achromatic condenser, and the adjustment of its focus upon the object (which is when its apex almost touches it) is made by giving it a spiral motion in the fitting—that is, carefully pushing it up or down at the same time that it is turned round by the milled edge. As the rays of light must be parallel when they enter it, the *Flat Mirror* is generally used; daylight will then require only direct reflection, but the rays from an artificial source will have to be made parallel by putting the Condenser between the light and the mirror, about 1¾ inches from the former

and 4½ inches from the latter. Nearly the whole surface of the mirror should be equally illuminated, which may be tested by temporarily placing upon it a card or piece of white paper.

Polarized Light, a beautiful appliance by which many objects otherwise almost invisible are shown in every imaginable color, can here only be treated of by describing the way in which it is applied to this Microscope by the following apparatus: A Nicol's prism as a polarizer fits, and can be turned round, in the fitting under the stage; another prism is fitted to an adapter which screws *above* the Object-glass, and also revolves. When, only alternate black and white images are given by the prisms alone, a film of selenite, fitted in a cap which slips *over* the Polarized prism, will produce colored ones.

To draw an object, the *Camera Lucida* is used. It slides on in the place of the cap of either Eyepiece, with its flat side uppermos,. The body of the Microscope must be in a horizontal position, and the whole instrument has to be raised until the edge of the prism is exactly 10 inches from a piece of paper placed upon the table. The light must be so regulated that no more than is really necessary is upon the object, whilst a full light should be thrown upon the paper. Only one eye is to be used; and, if one-half of the pupil be directed over the edge of the prism, the object will appear upon the paper, and can be traced on it by a pencil, the point of which will also be seen. Should any blueness be visible in the field the prism is pushed too far on, and should be drawn back till the color disappears.

Substituting in the place of the object a piece of glass ruled into 100ths and 1000ths of an inch, termed a *Micrometer*, its divisions can be marked on the same or another piece of paper, and, by comparing them with the sketch, the object can be most accurately measured. These divisions, also, if compared with a rule divided into inches and tenths, will give the magnifying power; thus, supposing 100ths of an inch when marked on the paper measured 1 inch and 3-10ths, the magnifying power would be 130.

The *Live-box* hardly needs description; the object is confined between the glass of the lower part and that of the cap; the distance between them can be varied by sliding the latter more or less on. As the thin glass is only dropped into a slight recess in the top of the cap, and is held there by the heads of the two screws, it can be easily taken out for wiping or be replaced by another when broken.

The *Glass Trough* for larger objects in water must be used with its thinner plate of glass in front. The modes of confining such objects and keeping them near the front surface must vary according to the occasion. For many it is a good plan to place a piece of glass diagonally in the trough, its lower edge being kept in its place by a strip at the bottom; then, if the object introduced is heavier than water, it will sink till stopped by the sloping plate. Sometimes a very slight spring may be applied behind this plate to advantage, with a wedge in front to regulate the depth.

Arrangements are made for all those parts which may require cleaning. Thus, the Parbolic Reflector unscrews from the table, the Nicol's Prisms will push out of their fittings, and the Camera-Lucida Prism can be taken out by turning aside the plate that covers it.

PRICES OF THE ECONOMIC MICROSCOPE AND APPARATUS.

No.		Price.
99.	**The Monocular Economic Microscope**, with sliding coarse adjustment, 1-inch and ¼-inch Object-glasses, one Eye-piece, Concave Mirror, Condensing Lens, glass plate with ledge, brass pliers, and Diaphragm, in Mahogany Case	$40 00
100.	The Monocular Economic Microscope, with Rack-and-pinion coarse adjustment, with 1-inch and ¼-inch Object-glasses, two Eye-pieces, Concave and Plane Mirrors, side Condensing Lens, Diaphragm, Stage-Forceps, pliers, glass slip with ledge, in Mahogany Case	55 00
101.	The Monocular Economic Microscope, with glass stage, and the same Object-glasses and accessories as are furnished with No. 100, in fine Upright Mahogany Case	65 00
102.	**The Binocular Economic Microscope**, with 1-inch and ¼-inch Object-glasses, two pairs of Eye-pieces, Concave and Plane Mirrors, side Condensing Lens for the illumination of opaque objects, movable glass stage, stage-forceps, pliers and glass plate with ledge, in Mahogany Case	85 00

THE NEW BINOCULAR NATIONAL MICROSCOPE.

103.	The New Binocular National Microscope, with *Concentrically Rotating Glass Stage*, and 1-inch (No. 695) and ¼-inch (No. 698) Object-glasses, having the respective apertures of 19 and 75 degrees, and magnifying from about 47 to 450 diameters; 2 pairs of Eye-pieces, Stage-forceps, Condensing Lens on stand (No. 691), a glass plate with ledge for the examination of objects in fluid, and a pair of pliers; the whole packed in an elegant French polished Mahogany Case, with good brass handle and lock, and a drawer for the accessories	110 00

DESCRIPTION.

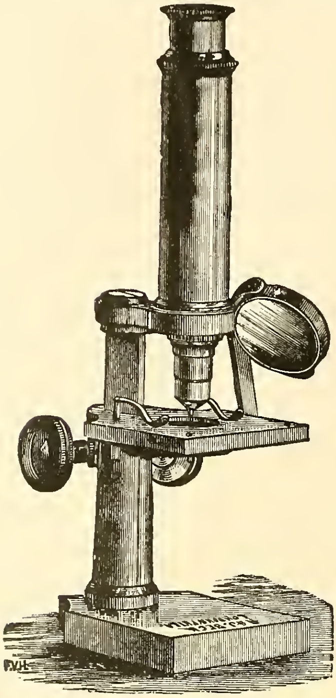
The Stand, which is 15 inches in height, is constructed entirely of brass, of the highest finish and best workmanship, having a broad, heavy *tripod* base. From the centre of this base rises a stout column, to the top of which is attached, by a firm joint, the *Jackson model* arm, carrying the compound body, by which the inclination can be varied to any degree, from vertical to horizontal, the whole instrument being perfectly steady and free from tremor in any position. The very highest powers may be used with it, as the body, being supported by the arm throughout its entire length, can not have any unsteadiness or motion of its own.

The quick Adjustment of Focus is effected by means of Rack and Pinion, with large Milled Heads, which works so smoothly that there is no need to use the Fine Adjustment for any power lower than ¼ of an inch. The latter adjustment is by means of a delicate Micrometer screw and lever attachment, working with absolute freedom from all motion, and by which the very highest powers may be focused with the greatest exactness.

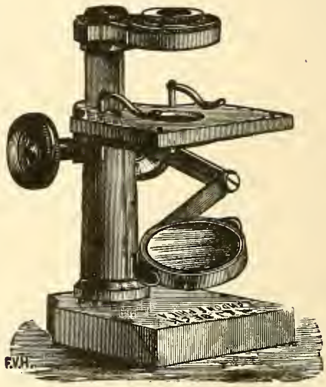
The Stage is of glass, with a complete rotation in the Optic Axis, upon the top of which is a sliding object-holder, very thin, and with a spring clip for holding the object in place during rotation. This clip is removable, in an instant, and the Stage forceps can be inserted in its place, thus allowing the latter to be moved about with the object-carrier. Beneath the Stage is a tube carrying all the sub-apparatus, as the Achromatic Condenser, Wenham's Parabola, Polarizing Apparatus, etc., etc. This is securely attached to the Stage by a bayonet catch, and can be instantly detached, leaving a very thin and unobstructed Stage for Oblique Illumination. The *Shutter Diaphragm* is of novel construction, with the various sized openings almost in contact with the underside of the object under examination, a great improvement upon the old revolving disk Diaphragm. A Double Mirror *Concave* and *Plane* is hung upon a swinging bar, and arranged with every possible motion for Direct and Oblique Illumination.

No.		Price.
134.	**The New National Monocular Microscope,** with *Concentrically Rotating Glass Stage*, and 1-inch (No. 695) and ¼-inch (No. 698) Object-glasses, having the respective apertures of 19 and 75 degrees, and magnifying from about 47 to 450 diameters ; 2 Eye-pieces, Stage-forceps, Condensing Lens on stand (No. 691), a glass plate with ledge and a pair of pliers ; the whole packed in an elegant French polished Mahogany Case, with good brass handle and lock, and a drawer for accessories	$85 00
135.	**The New Binocular National Microscope,** with 1-inch (No. 695) Object-glass, 1 pair of Eye-pieces, Nos. 1 or 2, as desired, Stage-forceps, Condensing Lens on stand (No. 691), glass plate and pliers, in Mahogany Case	95 00
136.	**The New Monocular National Microscope,** with 1 Eye-piece, Nos. 1 or 2, as desired, and the same Object-glass and fittings as with No. 135. In Mahogany Case	70 00
137.	**The New Binocular National Microscope Stand,** with 1 pair of Eye-pieces, Concave and Plane Mirrors, Diaphragm, Stage-forceps, glass plate and pliers	75 00
138.	**The New Monocular National Microscope Stand,** with 1 Eye-piece, Concave and Plane Mirrors, Diaphragm, Stage-forceps, glass plate and pliers	50 00

THE NEW HISTOLOGICAL DISSECTING MICROSCOPE.



No. 140.



No. 140.

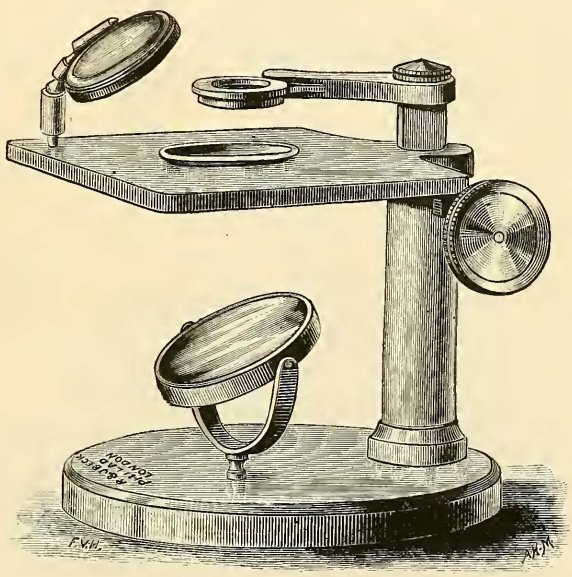
No.		Price.
140.	The New Histological Dissecting Microscope, with outfit as described below..............................	$25 00

This instrument combines a Compound Microscope with a Single and Dissecting one in a very compact, practical and economical form. The stout immovable arm carrying the lens when used as a Single Microscope is so arranged that a compound body with *Eye-piece* and *draw-tube* may be attached to its upper surface, whilst beneath it is fitted with the *Society Screw, whereby any objective may be used with it.* The Rack-and-Pinion adjustment works so smoothly that a $\frac{1}{4}$-inch objective may be focused with the utmost exactness. The Mirror beneath the stage is so adjusted upon a swinging arm that it may be turned up *over* the stage for the illumination of an opaque object. A revolving diaphragm, with various sized openings, is attached to the under side of the stage. The outfit consists of a single lens of 1-inch focus for dissecting and botanical work, and an achromatic objective of $\frac{1}{4}$-inch focus, the same as furnished with the Economic Microscopes, and one Eye-piece, giving a range of powers, with the draw-tube, of between 200 and 300 diameters, a pair of brass pliers, two dissecting needles in Ebony handles, and a glass plate with ledge. The whole packed in a neat Mahogany case with lock.

No.		Price.
141.	The New Histological Dissecting Microscope, with the same outfit as with 140 and the addition of the Economic 1-inch Objective..........	$32 00
142.	The New Histological Dissecting Microscope, same as with 140, with all the additional accessories necessary to make it the best and most complete Dissecting Microscope at present available to designers, at the same time meeting all the requirements of an "Examining" Microscrope..........	$40 00

To all who are unable to procure both single and compound Instruments, and still need both, this Instrument is especially recommended.

NEW MODEL DISSECTING SINGLE MICROSCOPE.



No. 150.

One-half Actual Size.

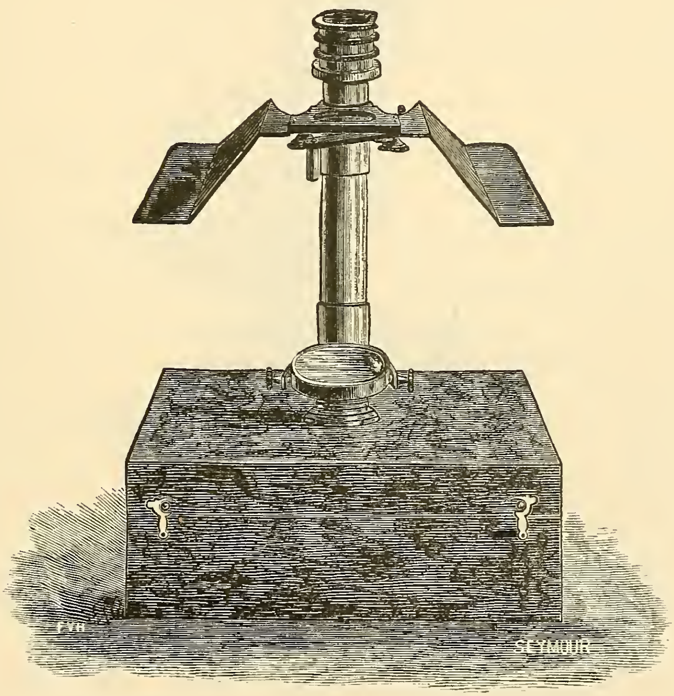
No.		Price.
150.	New Model Dissecting Single Microscope, Stand all brass, with broad circular Base and large firm Stage; Jointed Arm to to carry the lenses, with rack-and-pinion adjustment of focus; Concave Mirror and Side Condensing Lens, with complete adjustments; two *single* lenses of $1\frac{1}{2}$ and 1-inch focus; also, other important accessories. The whole packed in a strong Mahogany Case with handle and lock..........	$15 00

No.		Price.
151.	New Model Dissecting Single Microscope, *Stand only*, with Lens; no Case or Condenser	$10 00
152.	New Model Dissecting Single Microscope, with accessories and additions to make it a very complete instrument for dissecting or "picking out" patterns, as well as many other uses of the designing room and office	20 00

This instrument has been specially designed to meet a long-felt want for a thoroughly good dissecting Microscope at a very moderate cost. The Stand is very firm, with a roomy and convenient Stage of the exact height from table for convenient use; the lenses are exceedingly good, and of the most useful powers and the whole will be found very satisfactory for most purposes.

165.	**The Favorite Dissecting Microscope.** Plain brass base, which answers also for a convenient stage, sliding adjustment, 1 lens of 2-inch focus, another more powerful 1-inch focus. In neat case	10 00
166.	The Favorite Dissecting Microscope. Same as No. 165, but only one lens	6 00
167.	**The Amateur Dissecting Microscope.** Similar to No. 165, with elegant black walnut base, and several special accessories required by the beginner	8 00
168.	The Amateur Dissecting Microscope. Similar to No. 166, with black walnut base	5 00
169.	**The School Microscope**	6 00
170.	**The School Dissecting Microscope.** This instrument is the same as *The School Microscope*, No. 169, with the addition of two hand rests, which at once convert it into a most excellent and convenient *Dissecting Microscope*. They are attached to the stage by milled heads, and are instantly removed if desired. The whole, microscope, lenses and hand rests, can be packed in the case, which measures six by three inches, and two and a quarter inches deep. The lenses are of a most excellent quality, the stand firm and well finished, and it would seem impossible to improve on this really excellent instrument, either in compactness, efficiency or cheapness. The accompaniments are the same as those with No. 169	8 00

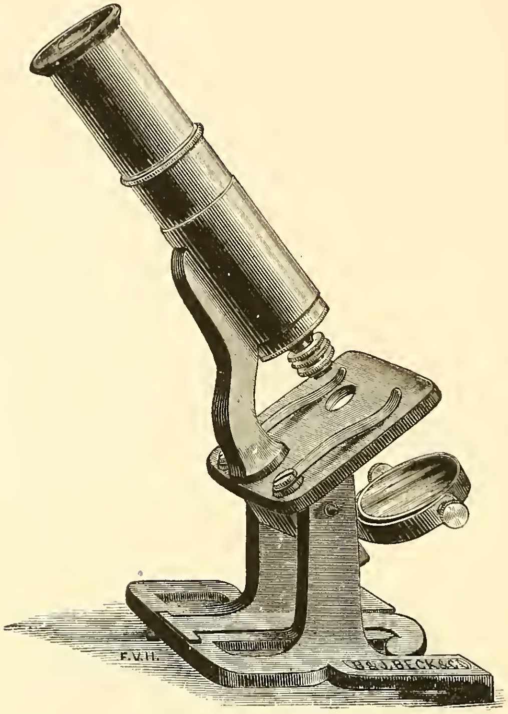
THE SCHOOL DISSECTING MICROSCOPE.



No. 170.

No.		Price.
171.	Same as No. 170, with necessary accessories to adapt it for dissecting patterns	$10 00
172.	**The Excelsior Pocket Microscope,** with three lenses	2 75
173.	With two lenses	2 50
174.	With three lenses and hard rubber slides, with square openings ¼ and ½-inch	3 00

THE UNIVERSAL HOUSEHOLD MICROSCOPE.



No. 180.

One-half Actual Size.

No.		Price.
180.	The Universal Household Microscope. There are a number of Microscopes under this name in the market, and in adding ours to the list, we have endeavored to add to their efficiency and convenience, whilst somewhat reducing the cost. The stand is ten inches in height, with hinged joint allowing it to be inclined to any angle for convenience of observation. The base is of cast iron, the design forming the monogram, R. & J. B., handsomely bronzed, the compound body of finely lacquered brass, with draw-tube for increasing the power. The Object-glass is of three powers, usable separately or combined, magnifying from about 20 to 100 *diameters*, or, in popular terms, from 400 to 10,000 *times*. The markings upon the scales of butterflies' wings, and most animalcules in pond-water, are very well shown by these glasses. A pair of brass forceps, two glass slips and one prepared object accompany it, the whole contained in a neat and strong walnut wood case....................	$5 00

No.		Price.
181.	THE UNIVERSAL HOUSEHOLD MICROSCOPE, the same as 180, with an *Achromatic Object-glass* of three powers, in place of the one furnished with 180, magnifying from 30 to 150 diameters, with excellent definition, entirely free from color..........................	$8 00
183.	THE UNIVERSAL HOUSEHOLD MICROSCOPE, with rack and pinion adjustment of focus, a Condensing Lens, for the illumination of opaque objects and an *Achromatic Object-glass* (Triplet), giving powers from about 30 to 250 diameters. The same fittings accompany it as are furnished with No. 660, and the whole is packed in a handsome French polished Mahogany Case........................	12 00

Our object of inserting these household instruments into this catalogue is not to extend the business beyond our line, but we do it because we know that many men engaged in factories would long ago have supplied their households with this unexcelled means of instructive entertainment, had they known just where to apply for what was wanted, or felt that they could depend upon a fair bargain if they did attempt such a purchase.

ACHROMATIC OBJECTIVES (FRENCH MANUFACTURE).

These Object-glasses are all *triple* combinations, excepting the first, which is a *doublet;* and are really well corrected lenses, giving a clear, well-lighted field with excellent definition. They all have the *French Screw* the same as that of No. 183, but can be fitted with the *Society Screw* for an additional cost of 75 cents each.

F. M. A. Achromatic Objective	No. 0, 1-inch,	doublet..................	$ 2 50
" " B. " "	" 1, ½ "	triplet..................	3 00
" " C. " "	" 2, ¼ "	"	3 50
" " D. " "	" 3, 1/6 "	"	4 00
" " E. " "	" 4, ⅛ "	"	5 00
" " F. " "	" 5, 1/10 "	"	7 00
" " G. " "	" 6, 1/15 "	"	10 00

HAND MAGNIFIERS, ETC.

200.	Oval-shape, Hard-rubber Case,	1 Lens,			about	¾-in. diam.		30
201.	" " " " "	1 "	-	-	"	1	"	50
204.	" " " " "	1 "	-	-	"	1¾	"	90
205.	Long-shape, " " "	1 "	-	-	"	¾	"	40
206.	" " " " "	1 "	-	-	"	15/16	"	60
207.	" " " " "	1 "	with dia'm,		"	⅝	"	75
208.	" " " " "	2 "	"	"	"	⅝	"	1 00
209.	" " " " "	3 "	"	"	"	⅝	"	1 50
215.	" " " " "	2 "	-	-	"	¾	"	65
216.	" " " " "	2 "	-	-	"	15/16	"	90
219.	" " " " "	3 "	-	-	"	¾	"	90
220.	" " " " "	3 "	-	-	"	15/16	"	1 25
221.	" " " " "	2 "	-	-	⅞ and ½		"	1 26

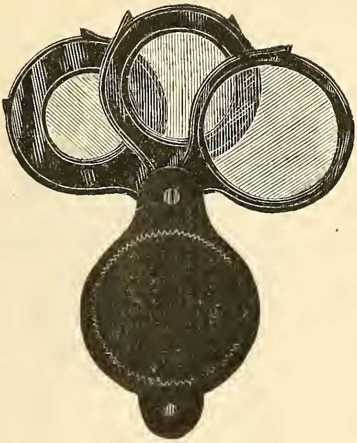
No.		Price.
225.	Linen-prover, Brass frame with ¼ or ½-in Open Square............	$0 50
226.	" " Nickel-plated, " " "	75
227.	" " " " " " Opening; Achromatic lens.	1 00
228.	" " Brass frame, 1 in. Open Square.....................	1 50

WATCHMAKERS' AND ENGRAVERS' GLASSES, etc.

230.	Watchmakers' Glass of ⅞, 1-inch, 1⅛-inches diameter, as desired.....	50
230.*	" " with two lenses, of different powers...........	75
231.	" " " small lens, high power........	75
232.	Engravers' " " 2 plano-convex lenses, 1⅜-inches "	1 50
232.*	" " " 1 double " lens, 1⅜-inches "	75
233.	" " " 2 plano " lenses, 1⅝-inches "	2 00
233.*	" " " 1 double " lens, 1⅝-inches "	1 00
234.	" " " 2 plano " lenses, 1⅞-inches "	2 50
234.*	" " " 1 double " lens, 1⅞-inches "	1 25
235.	" " " 2 plano " lenses, 2⅛-inches "	3 00
235.*	" " " 1 double " lens, 2⅛-inches "	1 50
236.	Seed Microscope, with glass cage for living insects, small size.......	75
236.*	" " " " " " medium size ...	1 00
237.	" " " " " " large size.......	1 50
238.	" " " forceps for living insects, folds in pocket-case,	2 00
239.	Three-legged Microscope, Brass frame, 2 plano-convex lenses, adjustment for focus..	75
240.	Three-legged Microscope, Rubber frame, 2 plano-convex lenses.....	1 00
241.	" " Steel frame, 2 plano-convex lenses........	1 25

CODDINGTON LENSES.

242.	Coddington lens, Brass frame, small size	$1 00
243.	" " " medium size	1 50
244.	" " " large size........................	2 00
245.	" " German-silver frame, with cover....	2 50
246.	" " Silver-plated " " very fine article....	4 00
247.	" " " and engraved, " " "	5 00
248.	" " Gilt " " " " "	6 00



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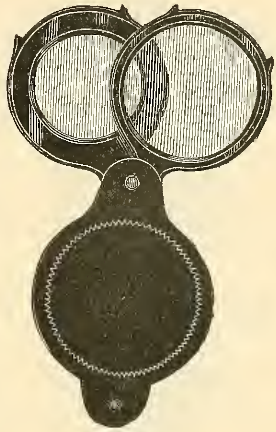

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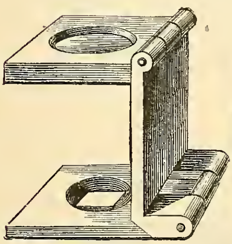

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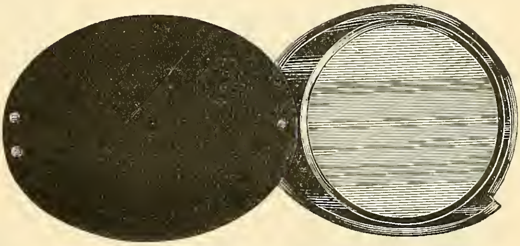

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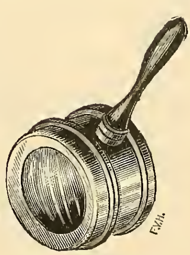

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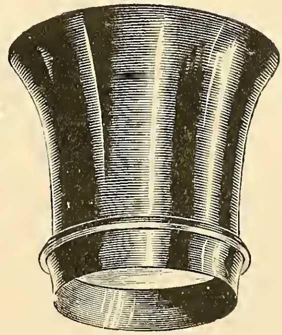

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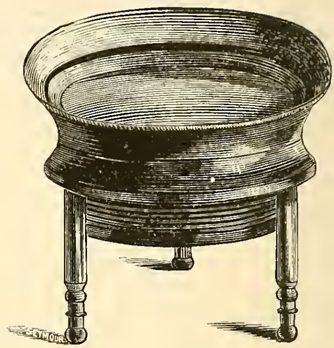
No. 230.*



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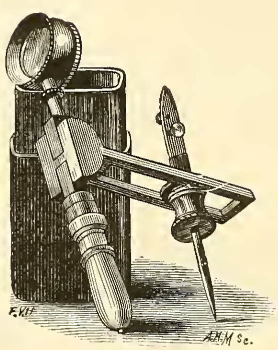

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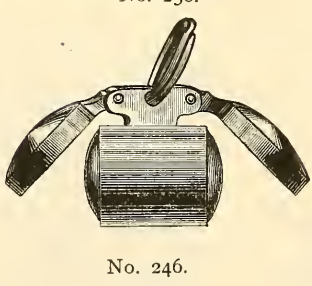

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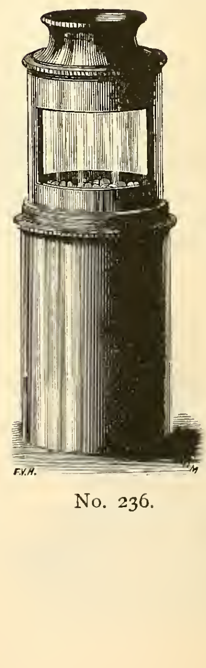
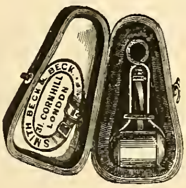


No. 236.

CODDINGTON LENSES, ETC.



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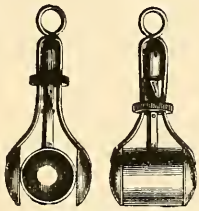

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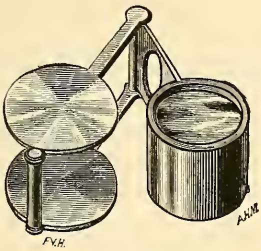

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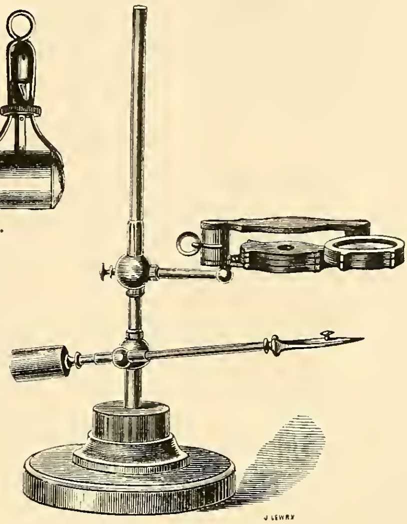


No. 343.

No.		Price.
343.	Combination of Three Lenses, mounted in Tortoise-shell, on Brass Stand, with Adjusting Arms and Sliding Forceps for holding an object	$10 00
344.	Combination of Three Lenses, in Tortoise-shell, on Brass Stand, with Adjusting Arm	7 00
346.	Combination of Three Lenses, mounted in Tortoise-shell, for pocket,	5 00
347.	Coddington Lens, ¾-inch focus, " " Silver	10 00
348.	" " ¾-inch " " " Aluminium Bronze	10 00
349.	" " ¾-inch " " " German Silver	8 00
350.	" " ½-inch " " " Gold	20 00
351.	" " ½-inch " " " Silver	7 50
352.	" " ½-inch " " " Aluminium Bronze	7 50
353.	" " ½-inch " " " German Silver	6 00

ACHROMATIC TRIPLETS.

355.	Beck's Achromatic Triplet, 1-inch focus, in Silver Case	$12 00
356.	" " " ¾-inch " " "	10 00
357.	" " " ½-inch " " "	10 00
358.	" " " ¼-inch " " "	12 00

DEMONSTRATION LENSES.

406. Demonstration Lenses. A set of six, 1¾ inches diameter, showing the forms of the various kinds of lenses, viz.: Double Convex, Double Concave, Plano-Convex, Plano-Concave, Meniscus Convex and Meniscus Concave. Per set $2 50

COSMORAMA LENSES.

409. Double or Plano-Convex Lens, 8 inches diameter, and either 30, 36, 48 or 72 inches focus, each 4 00
410. Double or Plano-Convex Lens, 7 inches diameter, same foci as 409, each 3 00
411. Double or Plano-Convex Lens, 6 inches diameter, of either 24, 30, 36, 48 or 72 inches focus, each 2 50
412. Double or Plano-Convex Lens, 5 inches diameter, of either 18, 20, 24, 30, 36, 48 or 72 inches focus, each 1 75
413. Double or Plano-Convex Lens, 4 inches diameter, of either 12, 14, 16, 18, 20, 24, 30, 36, 48 or 72 inches focus, each 1 25
414. Double or Plano-Convex Lens, 3 inches diameter, any focus 6 to 36 inches, each 75
415. Double or Plano-Convex Lens, 2 inches diameter, any focus 6 to 36 inches, each 60
416. Double or Plano-Convex Lens, 1¼ inches diameter, any focus 5 to 48 inches, each 50

MICROSCOPE AND TELESCOPE LENSES.

417.	Double	or Plano-Convex	Lens,	1	inch	diameter,	2	inches	focus......	75
418.	"	"	"	¾	"	"	1½	"	"	75
419.	"	"	"	⅝	"	"	1¼	"	"	75
420.	"	"	"	½	"	"	1	"	"	75
421.	"	"	"	⅜	"	"	¾	"	"	75
422.	"	"	"	¼	"	"	½	"	"	75
423.	"	"	"	3/16	"	"	¼	"	"	75
424.	"	"	"	⅛	"	"	⅛	"	"	75

ACHROMATIC OBJECT-GLASSES FOR SPY-GLASSES AND TELESCOPES.

425.	Achromatic	Object-glass,	1½	inches	diameter,	18 to 30	inches	focus,	2 00
426.	"	"	1¾	"	"	18 to 30	"	"	3 50
427.	"	"	2	"	"	18 to 30	"	"	4 00
428.	"	"	extra fine finish, 2 in. diameter, 36 in. focus,						6 00
429.	"	"	"	"	2½	"	44	"	10 00
430.	"	"	"	"	3	"	48	"	25 00
431.	"	"	"	"	3½	"	54	"	50 00
432.	"	"	"	"	4	"	60	"	80 00

PRISMS.

No.		Price
435.	Solid Flint Glass Prisms, 3 inches long, each	50
436.	" " 4 " "	60
437.	" " 5 " "	80
438.	" " 6 " "	1 00
439.	" " 7 " "	1 25
440.	" " 8 " "	1 50

READING AND PICTURE GLASSES.

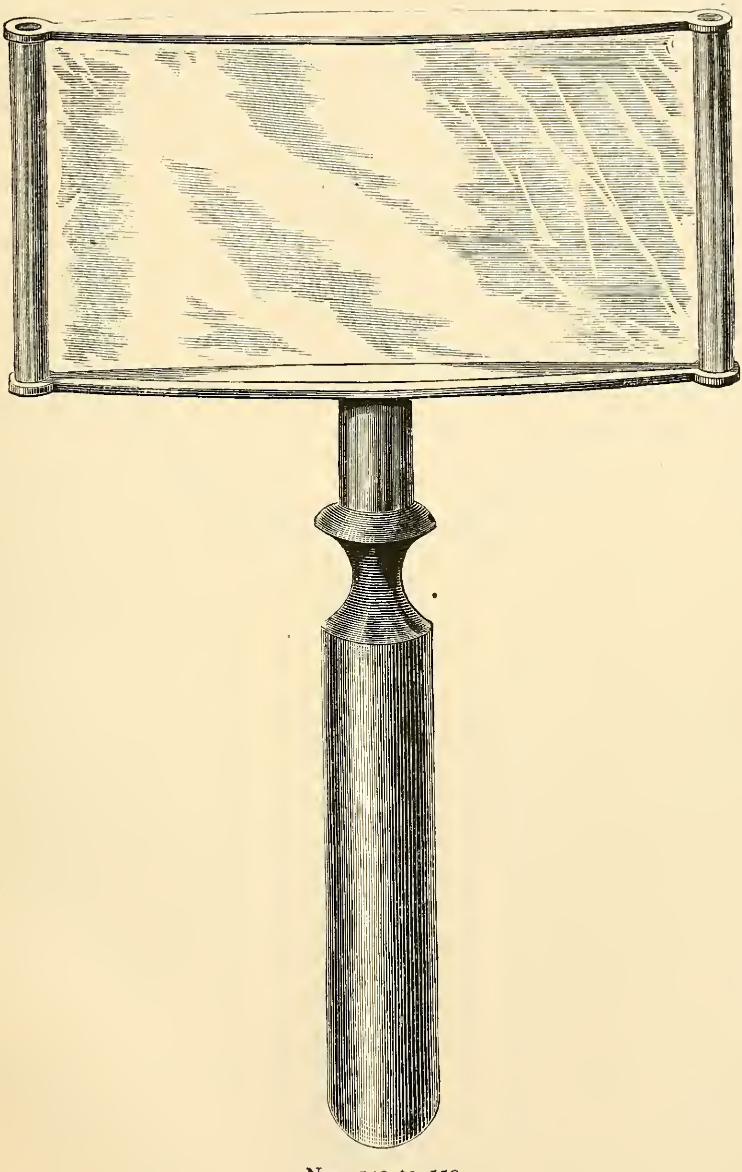
524.	Reading Glass, oxidized metal frame, double convex lens, 2 inches diameter	75
526.	Reading Glass, oxidized metal frame, double convex lens, 2½ inches diameter	1 00
527.	Reading Glass, oxidized metal frame, double convex lens, 3½ inches diameter	1 75
529.	Reading Glass, oxidized metal frame, double convex lens, 4½ inches diameter	3 00
530.	Reading Glass, gilt metal frame, ivory handle, one double convex lens, 2½ inches diameter	2 25
531.	Reading Glass, gilt metal frame, ivory handle, double convex lens, 4 inches diameter	4 00
532.	Reading Glass, black metal frame, wood handle, double convex lens, 3 inches long by 1½ inches wide	1 25
533.	Reading Glass, black metal frame, wood handle, double convex lens, 4 inches long by 2 inches wide	2 00
534.	Picture Glasses, wood frame and handle, double convex lens, 5 inches diameter	4 00
535.	Picture Glasses, wood frame and handle, double convex lens, 6 inches diameter	5 00

DOUBLE CYLINDRICAL READING GLASSES.

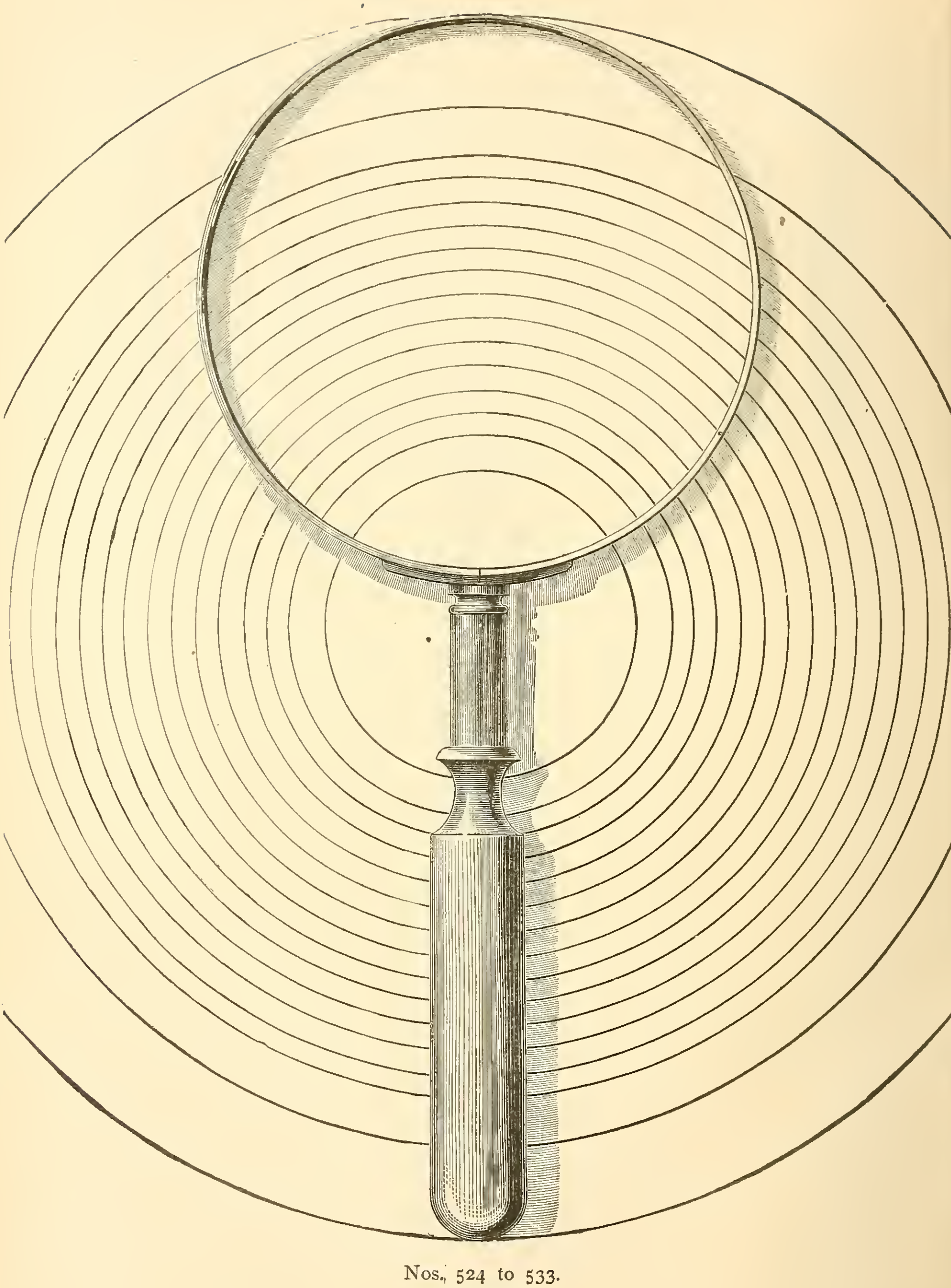
These entirely new and very superior Reading Glasses are made of a double cylindrical lens, with its axes crossing at right angles, giving an entirely flat field free from chromatic or spherical aberration, reading to the extreme edge. Their great superiority to the old form of double convex lenses is apparent at a glance.

540.	Reading Glass, double cylindrical, German silver frame, black handle, 2x3 inches	2 50
541.	Reading Glass, double cylindrical, German silver frame, black handle, $2\frac{3}{16}$x3½ inches	3 50
542.	Reading Glass, double cylindrical, German silver frame, black handle, $2\frac{5}{16}$x3¾ inches	4 50
543.	Reading Glass, double cylindrical, German silver frame, black handle, 2¾x4½ inches	5 50

No.		Price.
544.	Reading Glass, double cylindrical, German silver frame, black handle, $2\frac{7}{8}$x$4\frac{1}{2}$ inches	\$6 50
545.	Reading Glass, double cylindrical, German silver frame, ivory handle, 2x3 inches	4 00
546.	Reading Glass, double cylindrical, German silver frame, ivory handle, $2\frac{3}{16}$x$3\frac{1}{4}$ inches	5 00
547.	Reading Glass, double cylindrical, German silver frame, ivory handle, $2\frac{5}{16}$x$3\frac{3}{4}$ inches	6 00
548.	Reading Glass, double cylindrical, gilt frame, ivory handle, $2\frac{3}{16}$x$3\frac{1}{4}$ inches	\$6 00
549.	Reading Glass, double cylindrical, gilt frame, ivory handle, $2\frac{3}{4}$x$4\frac{1}{4}$ inches	9 50
550.	Reading Glass, double cylindrical, gilt frame, ivory handle, $2\frac{7}{8}$x$4\frac{1}{2}$ inches	10 50



Nos. 540 to 550.



Nos. 524 to 533.

PRICES OF THE ECONOMIC MICROSCOPE APPARATUS.

No.		Price.
664.	Eye-pieces for 100. Nos. 1, 2 or 3, each	$4 50
665.	Eye-pieces for 101. Nos. 1, 2 or 3, each	5 00
666.	Side Condensing Lens	2 50
667.	Stage-Forceps	2 50
668.	Pliers	35

ADDITIONAL APPARATUS.

630.	Lieberkuhn to 1-inch Object-Glass	3 00
640.	Dark Well	2 00
641.	Achromatic Condenser and Fitting	8 00
642.	Wenham's Parabolic Reflector, for Dark-field Illumination	8 00
643.	Flat Mirror for 99, (in which case a double one is substituted for the concave single one, which has to be returned,)	2 75
644.	Polarizing Apparatus, complete with Prisms, film of Selenite, and adapter	13 50
645.	Wollaston's Camera Lucida, for drawing an object	6 50
646.	Glass Micrometer, ruled into $\frac{1}{100}$ths and $\frac{1}{1000}$ths of an inch	2 00
647.	Small Live-Box	2 50
648.	Glass Trough, complete with Wedge and Spring	2 50
649.	All the above "Additional Apparatus," Nos. 630 to 649, if ordered at once	40 00
650.	Vertical Camera Lucida for drawing objects	8 00

NEW NATIONAL SERIES OF OBJECTIVES.

In order to meet the universal demand for good and well corrected Object-glasses adapted to the wants of true observers, who need reliable glasses at a moderate cost, impossible in lenses of the very highest grade, we have now introduced Beck's *New National Series*, which we confidently recommend as the best low-priced Objectives ever made. They are corrected with great care, are exceedingly well mounted, furnished with the Society Screw, and packed in handsome engraved Brass Boxes. The Series is as follows:

No	Focal Length.	Linear magnifying power nearly, Draw Tubes.	with Eye-pieces.			Degrees of angle of aperture.	Price.
			No. 1.	No. 2.	No. 3.		
693	3 in.	closed	12	20	32	7°	$ 7 00
694	2 in.	closed	23	43	70	10°	7 00
695	1 in.	closed	47	78	116	19°	9 00
696	$\frac{2}{3}$ in.	closed	65	110	170	25°	10 00
697	$\frac{1}{2}$ in.	closed	100	170	260	38°	12 00
698	$\frac{1}{4}$ in.	closed	200	340	520	75°	12 00
698*	$\frac{1}{6}$ in.	closed	275	480	750	85°	15 00
699	$\frac{1}{8}$ in.	closed	365	620	965	95°	20 00
699*	$\frac{1}{16}$ in.	closed	730	1240	1930	110°	30 00
700	$\frac{1}{20}$ in.	closed	900	1550	2500	120°	45 00

ADDITIONAL APPARATUS.

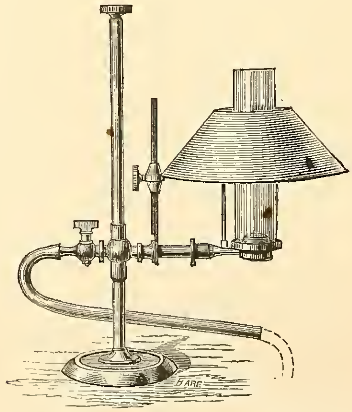
No.		Price.
639.	Lieberkuhn to 1-inch Object-glass	$ 3 50
651.	All the above Additional Apparatus, from Nos. 630 to 649, not including 645, if ordered at once	40 00
653.	Double Nose Piece, Angular	7 00
653*.	Triple Nose Piece "	15 00
662.	Eye-pieces, Nos. 1, 2 or 3, for New National Microscopes, each	5 50
690.	Stage, with Horizontal and Vertical Mechanical Movements, Sliding Object-holder, and Revolving Fitting, complete	20 00
691.	Condensing Lens on Stand	6 00
692.	Draw-tube for "The National Microscope"	3 50

Nos. 640 to 650 inclusive are applicable to these instruments.

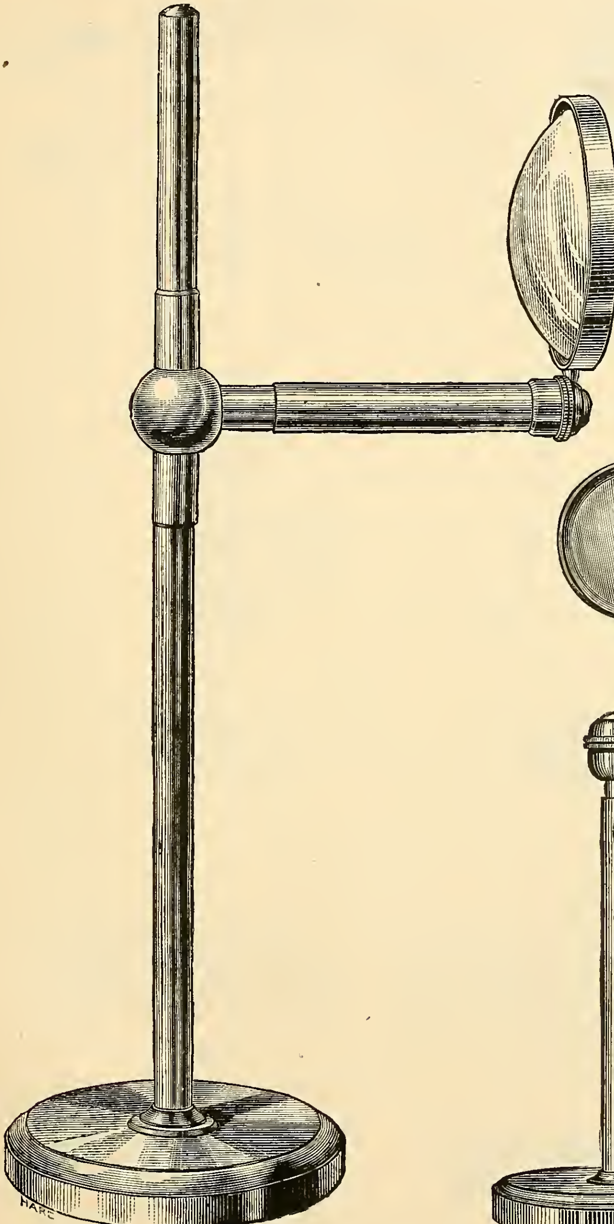
ACHROMATIC OBJECTIVES (FRENCH MANUFACTURE).

These Object-glasses are all *triple* combinations; excepting the first, which is a *doublet;* and are really well corrected lenses, giving a clear, well-lighted field with excellent definition. They all have the *French Screw* the same as that of No. 175, but can be fitted with the *Society Screw* for an additional cost of 75 cents each.

764.	Achromatic Objective No. 0, 1-inch, doublet	2 50
765.	" " " 1, $\frac{1}{2}$ " triplet	3 00
766.	" " " 2, $\frac{1}{4}$ " "	3 50
767.	" " " 3, $\frac{1}{6}$ " "	4 00
768.	" " " 4, $\frac{1}{8}$ " "	5 00
769.	" " " 5, $\frac{1}{10}$ " "	7 00
770.	" " " 6, $\frac{1}{15}$ " "	10 00



No. 888. (*See Page* 37.)



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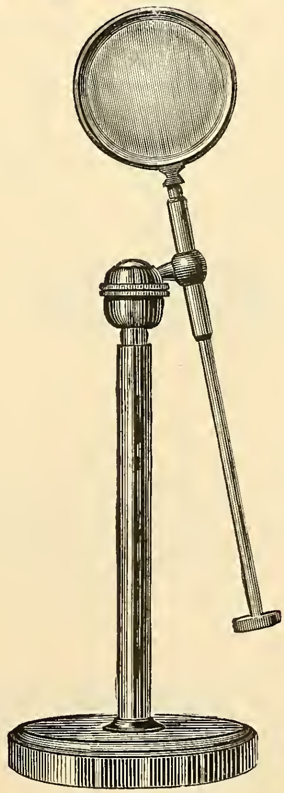

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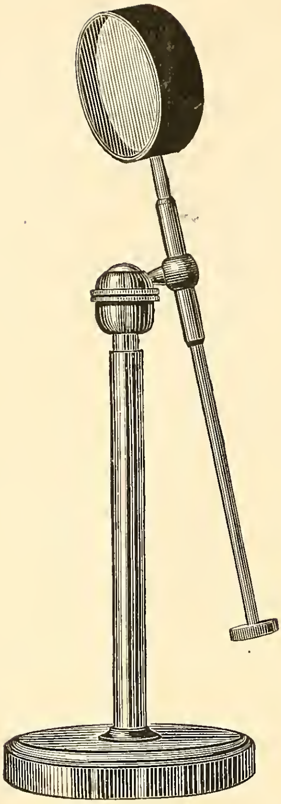

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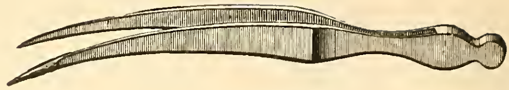

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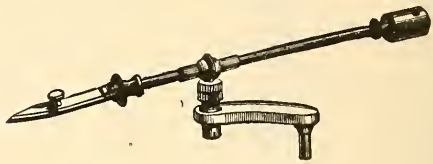

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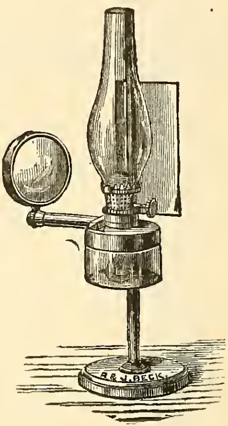

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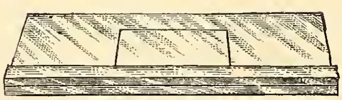

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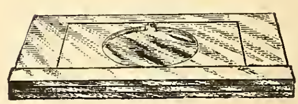

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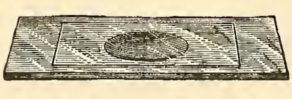

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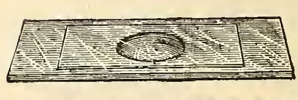
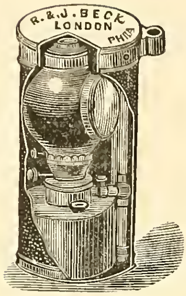


No. 891.

APPARATUS AND ACCESSORIES.

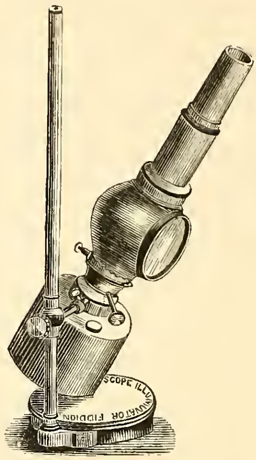
No.		Price.
806.	Amici's Prism on Separate Stand	$17 00
811.	Equilateral Prism on Separate Stand for oblique illumination	8 50
812.	Adapter on Stand for use of Object-glass as Condenser	5 00
830.	Large Bull's-eye Condensing Lens on Stand	8 50
830*.	Large Bull's-eye Condensing Lens with Lamp attached	12 50
832.	Smaller Condensing Lens on Stand	6 00
834.	Side Silver Reflector on Stand	8 50
835.	Rainey's Light Moderator on Stand	8 50
842.	Three-pronged Forceps, in German Silver, with Screw Adjustment	7 00
843.	Three-pronged Forceps	6 00
844.	Stage Forceps	3 50
844*.	Paper-pointed Forceps	50
846.	Eye-piece Micrometer, with Jackson's Adjusting Screw	8 50
847.	Stage Micrometer, mounted in brass	4 50
848.	Stage Micrometer, mounted in card	2 25
849.	Stage Micrometer, mounted in brass, parts of English Inch and Millimetre	6 00
849*.	Stage Micrometer, mounted in card, parts of English Inch and Millimetre	3 50
871.	Glass Slip with Ledge	40
872.	Growing-cell, for preserving objects alive in water for many days	4 50
873.	Set of Six Live-traps and Trough, in Case, çomplete	12 50
874.	Live-trap	3 00
875.	Frog-plate, with Bag, etc., complete	4 50
876.	Glass Slip, with Hollow and Ledge	50
877.	Glass Slip, with Hollow and Ledge and Lip	1 50
878.	Glass Slip, with Hollow	15
880.	Glass Tubes, Set of Three	50
882.	Opal Glass, for Moderating the Light, 3x1 inch	40
883.	Blue Glass, for Moderating the Light, 3x1 inch	40
886.	Astral Oil Lamp, Flat Wick and Shade, with arrangement for varying height of flame above the table	6 50
886*.	Case for Lamp, No. 186, and 1 chimney	4 00
888.	Gas Lamp, Argand Burner, Shade and six feet of flexible tubing, with arrangements for varying height of flame above the table (*See Page* 34.)	13 50
889.	Fiddian's Microscope Illuminator, in Case	15 00
890.	Lamp Chimneys, for Nos. 886* or 888*	20
891.	Weber's Slip, with Convex Cell	75

FIDDIAN'S MICROSCOPE ILLUMINATOR.



898.

LAMP WHEN PACKED IN CASE.



898. LAMP.

898.

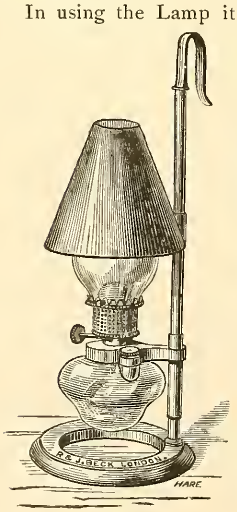
EXTERIOR OF CASE.

No. 898. Fiddian's Microscope Illuminator, nickel plated......... $15 00

This very convenient and useful Lamp has been designed to combine the qualities of other Microscope Lamps, together with greater portability, the whole fitting into a brass tubular box, the exterior of which is covered with morocco leather, the lid forming the stand of the Lamp. The metallic chimney being telescopic, occupies a very small compass ; the condenser fits into the cell in front. The reservoir is of brass, and will contain sufficient petroleum for six hours' consumption. The entire Lamp fitting into the case from the top, escape of the oil is prevented.

In trimming the Lamp care should be taken that the wick is perfectly dry, and the petroleum of good quality ; also that none of the oil gets upon the metallic chimney or reservoir, or a bad smell will be given off until the oil is burnt away.

In using the Lamp it will be found convenient to slightly incline it, so as to bring the broad surface of the flame more parallel with the surface of the mirror of the Microscope.



899.

When it is necessary to re-line the chimney, screw off the sliding portion, wash out the old lining, and recoat it with superfine Plaster of Paris. When dry it will be found ready for use—a few minutes will be found sufficient to do this.

Size of Case:—Height, 6 *inches; Diameter,* 3 *inches.*

899. Beck's Microscope Lamp. This very portable, simple, and cheap lamp, is arranged to carry the flame at any desired height above the table, thus adapting it to the use of all sizes of Microscopes. The shade is of paper, enamelled green on the exterior, affording full protection to the eyes, and emitting no heat. The base is heavy, and the lamp perfectly steady at any height........ .... $5 00

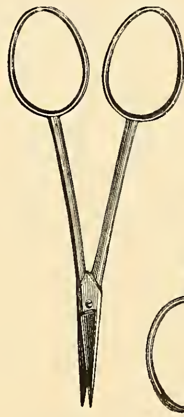
900. German Student Lamp. Brass......... 5 00

901. " " " Nickel-plated.. 6 00

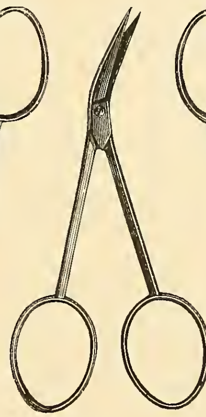
No.		Price.
902.	Dissecting Lamp. Large base, with Condenser and Chimney. Also, an upper shade and reflector combined to shade the eyes and intensify the light on the work. With box	$10 00
	Without box	8 00
902.*	Smaller Dissecting Lamp, with box	7 00
	Without box	5 00
902.**	Smaller Dissecting Lamp	4 00
902.***	Condensers, Separate, from $1.00 to	5 00
902.****	Lamps, with Shades, from $2.00 to	6 00

902***. These condensers are furnished separate or with fixtures to attach to lamp 902****, or on stands.

902****. The Shades for these lamps are of various shapes. When ordering, state what instrument is used ; or, if none, what position is occupied while dissecting.



No. 911.



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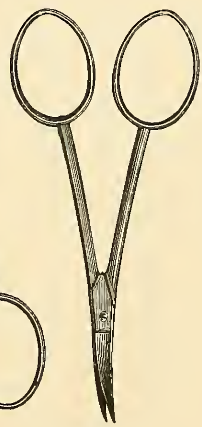
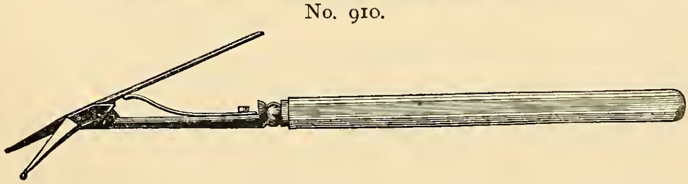


No. 912.

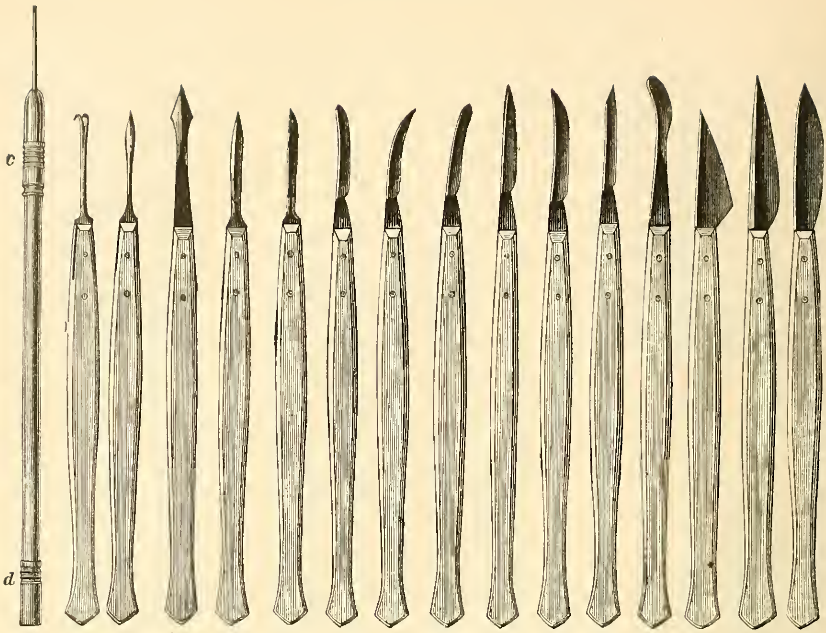
No. 909.

No. 910.

No. 923.



No. 915,



1. 2. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18.

Nos. 916–919.

No.		Price.
903.	FORCEPS, brass, 3 inches long	25
904.	" Quekett's, for taking objects out of deep bottles	2 50
905.	" Bull-nose	1 00
906.	" Cutting	2 50
906*.	" opening by pressure	2 00
907.	" Steel Nickel-plated, straight, 4 inches long	1 00
908.	" " " curved, 4 "	1 00
909.	" " " " 4 " very delicate	1 50
910.	" " " straight, 4 " " "	1 50
911.	SCISSORS for dissecting, straight blades, very delicate	1 50
912.	" " blades curved on the flat	1 50
913.	" " elbow blades	1 50

Nos. 911, 912 and 913 are of most excellent quality and finish; 912 is without doubt the most convenient and safest instrument available for clearing a sample of woolen goods of the nap on back or face. There is no danger of smut as with singeing, or of scraping and cutting as in shaving, even with the best knife.

Nos. 911*, 912* and 913*	are similar, also very fine, each	1 00
911**.	Fine Scissors, straight blades, blunt or sharp points	75
911***.	Small Scissors, straight blades, blunt or sharp points	50
914.	Scissors for dissecting, very strong	1 25
915.	Scissors for dissecting, with spring, exceedingly delicate	6 00
916.	Needle-holder for Dissecting Needles, Fig. 1	75

No.		Price.
916*.	Needle-holder for Dissecting Needles,	65
916**.	" " "	50
916***.	" " "	25
917.	" " straight point, ebony handle	15
917*.	" " " metalic handle	25
917**.	" " " "	10
918.	Needle-hook for dissecting	15
918*.	" for dissecting double points. Fig. 2	75
918**.	" for dissecting triple points. Fig. 3	1 00
919.	Knives for dissecting, Figs. 5 to 18 (very convenient in the designing room), each	75
920.	Case of Dissecting Instruments, containing 1 pair forceps, 1 pair scissors, 2 dissecting knives No. 919, 2 needle-holders, with needles.	7 50
921.	Case of Dissecting Instruments, containing 2 pair forceps, 2 pair scissors, 3 dissecting knives, 2 needle-holders, with needles, 1 Valentine's knife. (We can furnish cases with any number of pieces to order).	15 00
922.	Dr. Ranvier's "Necessaire"	3 00

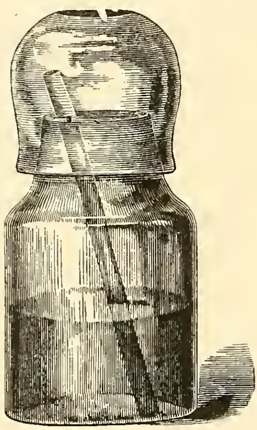
This indispensable little piece of apparatus, which is in use in all the Hospitals in Paris, and by most Microscopists there, consists of a circular base of polished wood, in which are arranged six reagent bottles, with ground capillary-tube stoppers, the whole covered with a low bell-glass, to exclude dust.

923.	Knife, Valentine's, for cutting sections of soft tissues	6 50
924.	Knife, for use with section cutters, in Morocco Case	3 50
925.	Knife, for use with section cutters, heavy blade, in Morocco Case	5 00

These knives are guaranteed to be of the very first quality. Each is ground flat on one side and hollow on the other, and can be furnished to cut toward or from the operator, as desired. They are especially convenient for shaving the nap of samples before dissecting.

928.	Glass Cells, of various sizes, shapes and depths, per dozen	1 00
929.	Block-Tin Cells, of various sizes and depths, for fluid and balsam mountings, per dozen	50
930.	Hard-Rubber Cells, of various sizes and depths, for dry and opaque mountings, per dozen	15
931.	Thin Glass, in sheets, No. 3, $\frac{1}{50}$ to $\frac{1}{100}$, per oz	75
932.	" " " 2, $\frac{1}{100}$ to $\frac{1}{150}$ "	1 00
933.	" " " 1, $\frac{1}{150}$ to $\frac{1}{200}$, or thinner, per oz	1 50
935.	" in squares, " 3, per dozen, 18 cents "	1 25
936.	" " " 2, " 20 " "	2 25
937.	" " " 1, " 25 " "	2 75
938.	" in circles, " 3, " 20 " "	2 25
939.	" " " 2, " 25 " "	2 75
940.	" " " 1, " 30 " "	3 75
941.	Watch Glasses, all sizes, each 7 cents, per dozen	75
942.	Dipping and Dropping Tubes, each	10
943.	Pippits, with bulb	25
944.	Test Tubes, all sizes, each, 3 to 8 cents, per dozen	30 to 75
945.	Bell Glass, for preserving objects from dust during preparation	50

No.		Price.
947.	Canada Balsam, pure, in collapsible tubes...............	25
948.	" " in chloroform, requires no heat, per bottle....	50
949.	" " in Benzole,. " " "	50
950.	Damar, " " "	50
951.	Glycerine, pure, "	25
952.	Glycerine, Camphorated, for mounting fresh-water algæ, per bottle..	25
953.	" Jelly	50
954.	Deane's Medium..	35
955.	Farrant's Medium......................................	60
956.	Absolute Alcohol, (Dr. Squibb's)................................	25
957.	Benzole, pure..	25
958.	Brunswick Black..	25
959.	Asphalte...	25
960.	Gold-Size..	25



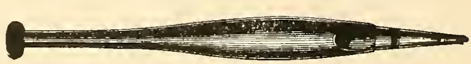
No. 969.

No. 947.

No. 961.

961.	Marine Glue, per bottle....................................	35
962.	Oil of Cloves "	50
963.	Bell's Cement, "	50
963.*	Brown's Transparent Rubber Cement, per bottle	35
964.	White Zinc Cement, "	50
965.	Punches, various sizes, ½ inch to 1 inch.................each, 50 to	1 50
965.*	Improved Punch for cutting cells from Sheet Wax.............	1 50
966.	Instrument for cutting circles of thin glass, in case................	10 00
967.	Glaziers' Diamonds, from.................................... 4 00 to	10 00
968.	Writing Diamonds, each......................................	3 50

No. 967.



No. 968.

No.		Price.
969.	Capped Bottles for containing fluid used in mounting objects, each...	50
970.	Dropping Bottles with glass bulb stopper, each....................	25
971.	Dropping Bottles with rubber top stopper, each	30
972.	Small Collecting Bottles, per dozen..........................	30 to 1 00
972*.	Capillary Bottles each..	40
973.	Wright's Diatom Collecting Bottle, complete in case...............	4 00
974.	MOUNTING CABINET, as arranged by Mr. Walmsley; containing 6 compressors, *wood*, 6 ditto nickel-plated, Steel Forceps, Scissors, Knife, Needles, Turn-table. Brass Table and Lamp, gross slips, ½ oz. assorted Squares and Circles, 1 doz. Hard-Rubber Cells, 1 doz. Block-tin Cells, 3 Watch-glasses, Dropping Tube, Tube of Balsam, Damar or Balsam, Glycerine, Glycerine Jelly, Hæmatoxylon, Brunswick Black, Gold-size, Oil of Cloves, White Zinc Cement, Dropping Bottle, 1 Nest of Saucers, wide-mouth Glass Jar for Solutions, 2 Camel's-hair Brushes in long handles. The whole packed in a polished mahogany cabinet with lock	25 00
975.	Porcelain Saucers, in nests of 5 with cover, all fitting dust tight. The most useful of all articles in staining tissues and soaking in oil of cloves (two sizes)	60 and 80
976.	Hot-water Drying Case, for drying tissues and hardening Balsam mountings, made entirely of heavy Planished Copper; will harden twelve dozen specimens at once....................................	15 00

STAINING AND INJECTING FLUIDS, ETC.

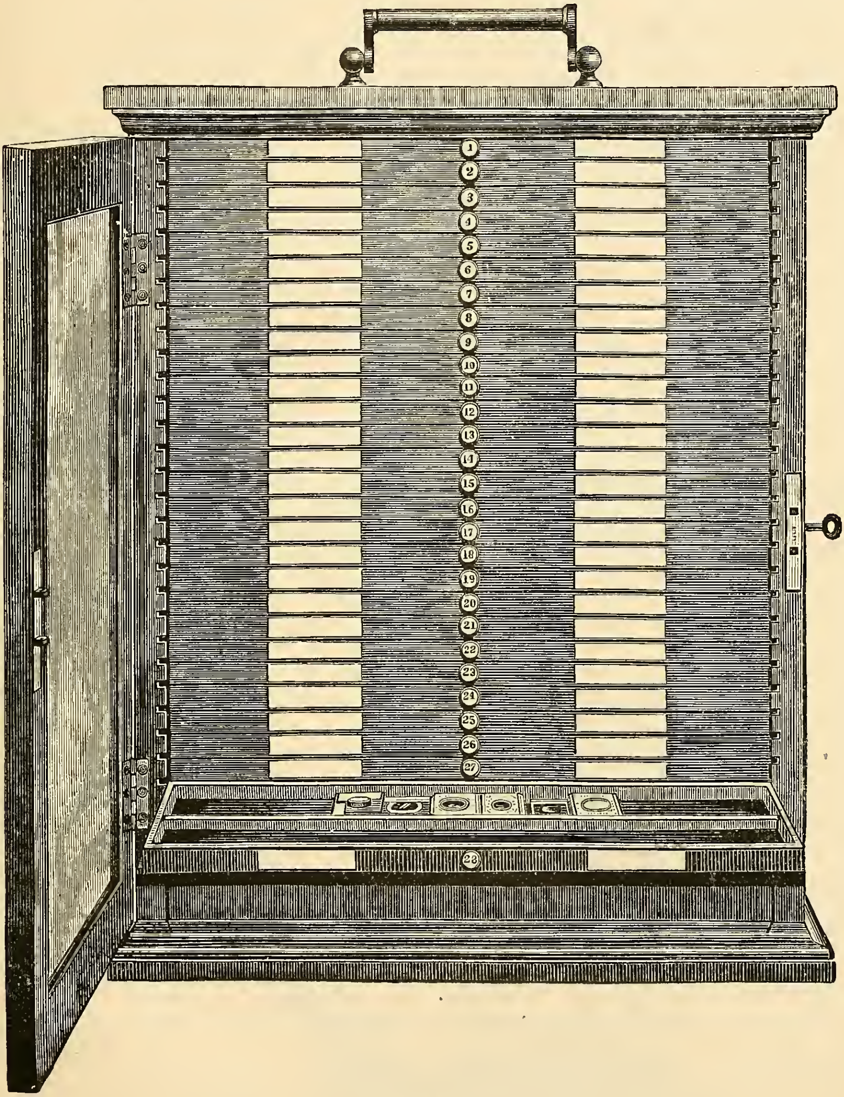
No.		Price
977.	Hæmatoxylon, per bottle..	25
978.	Ammonia Carmine, per bottle....................................	25
979.	Borax Carmine, per bottle.....	25
980.	Carmine Red, per bottle	35
981.	Dr. Woodward's Violet Carmine, per bottle.......................	25
982.	Methyl Aniline, Green, per bottle................................	25
983.	Magenta Aniline, Red, per bottle	25
984.	Blue Aniline, per bottle..	25
985.	Eosin, per bottle	25
986.	Osmic Acid, $\frac{1}{32}$ oz. in glass capsule.................................	3 00
987.	Picro Carmine, per bottle...	25
988.	Sulphindigotate of Soda (Dr. Seiler's), per bottle..................	25
989.	Carmine Injecting, Gelatine (Dr. Seiler's), per oz................. One ounce of this Gelatine dissolved in ten ounces of distilled water forms an admirable Injecting Fluid.	1 00
990.	Adhesive Labels, Plain White, Round or Oval, per box......	10
991.	" " Assorted Colors, Square, neatly bordered, per 100..	25
992.	" Fronts for covering slides, handsome gold design, per 100..	50
993.	" " for covering slides, handsome bronze design, per 100,	30
994.	Backs for covering slides, per 100	10
	Backs or fronts if with holes punched, *extra*, per 100...............	15

DISSECTING BRUSHES, ETC.

No.		Price.
995.	Dissecting Brushes for clearing the threads of a sample after ravelling out a few threads	75
996.	Dissecting Brush	50
997.	" "	25
998.	Perforated Card Board Sample Stretcher for dissecting stage	5
998*.	" White Wood " " "	10
998**.	" Nickle-plated " " "	25
999.	A set of 20 different textile fibers, properly and separately mounted on microscopic slides. Necessary if a thorough study of fibers is undertaken. Price per slide 60 cents. Per set	10 00

Send 30 cents for R. & J. Beck's Catalogue of Microscopic Objects, &c., &c.

CABINET FOR MICROSCOPIC OBJECTS.



No, 1466.

BEST SPANISH MAHOGANY CABINET, with glass panel and deep drawers at bottom, to hold 1,000 objects.............................. $70 00

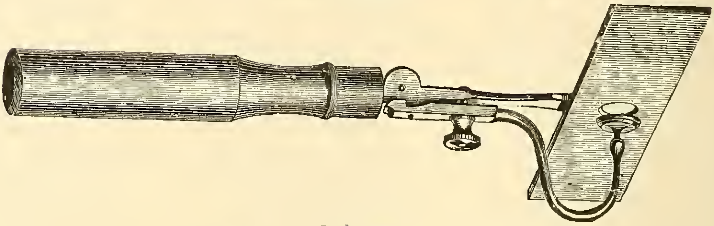
We can furnish any of R. & J. BECK'S London and Phildelphia goods in this line at their lowest retail prices.

CASES OF MOUNTING MATERIALS.

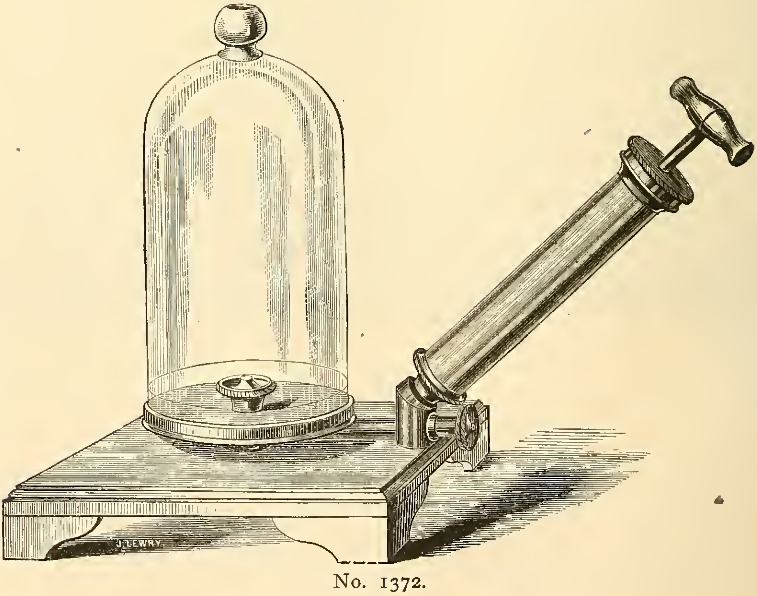
1360. COLLECTION OF MOUNTING MATERIALS AND DISSECTING INSTRUMENTS, consisting of Wood-cutting Instrument and Chisel, instrument for cutting circles of thin glass, Glazier's Diamond, Writing Diamond, Cell-making Instrument, Brass Table and Lamp, Page's Forceps, Case of Dissecting Instruments containing 4 Knives, 2 Hooks, 2 Points, 3 pairs of Scissors, 3 Pairs of Forceps and Needle-holder, Valentine's Knife, 1 oz. Thin Glass, 9 dozen Slips 3 inch by 1 inch, 3 dozen Wooden Slips, 3 dozen Glass Cells, 200 Labels, 5 Capped Bottles containing Canada Balsam, Asphalt, Gold-size, Glycerine and Marine Glue, Bottle of Dean's Medium, 3 Stoppered Bottles for containing Chloroform, Nitric Acid and Liq. Potasse,..$100 00

The whole packed in a Strong Mahogany Case.

No. 1369.



No. 1370.



No. 1372.

CASES OF MOUNTING MATERIALS.

No.		Price.
1361.	Collection of Mounting Materials, consisting of Writing Diamond, Cell-making Instrument, Brass Table and Lamp, Page's Forceps, Case for Dissecting Instruments, 1 oz. Thin Glass, 6 dozen Slips 3 inch by 1 inch, 3 dozen Wooden Slips, 2 dozen Glass Cells, 150 Labels, 5 Capped Bottles containing Canada Balsam, Asphalt, Gold-size, Glycerine and Marine Glue, 1 bottle of Deane's Medium	$40 00

The whole packed in a strong Mahogany Case.

1365.	Reagent and Mounting Rack, containing 12 bottles filled with various reagents, cements, etc., each provided with a dropping tube fitted to the cork, and 10 test tubes with fittings	3 00
1368.	Improved Wood Cutting Machine, with Chisel, packed in Mahogany Case	9 50
1369.	Page's Wooden Forceps for holding Glass Slips when heated	50
1370.	Smith's Mounting Instrument for pressing down the Cover on the Glass Slips, with a graduated pressure	3 00
1372.	Small Air-pump and Receiver	12 50

CABINETS FOR MICROSCOPIC OBJECTS.

1465.	Mahogany Cabinet to hold 600 objects, with double glass doors and improved slide-rests, showing each object clearly when the drawers are pulled out, and allowing their easy removal	45 00
1466.	Best Spanish Mahogany Cabinet, with glass panel and deep drawers at bottom, to hold 1,000 objects	70 00
1467.	Honduras Mahogany Cabinet, without glass panel or deep drawers, to hold 1,000 objects	55 00
1468.	Best Spanish Mahogany Cabinet, with glass panel, to hold 750 objects	50 00
1469.	Honduras Mahogany Cabinet, without glass panel, to hold 750 objects	44 00
1470.	Best Spanish Mahogany Cabinet, with glass panel, to hold 500 objects	40 00
1471.	Honduras Mahogany Cabinet, without glass panel, to hold 500 objects	35 00

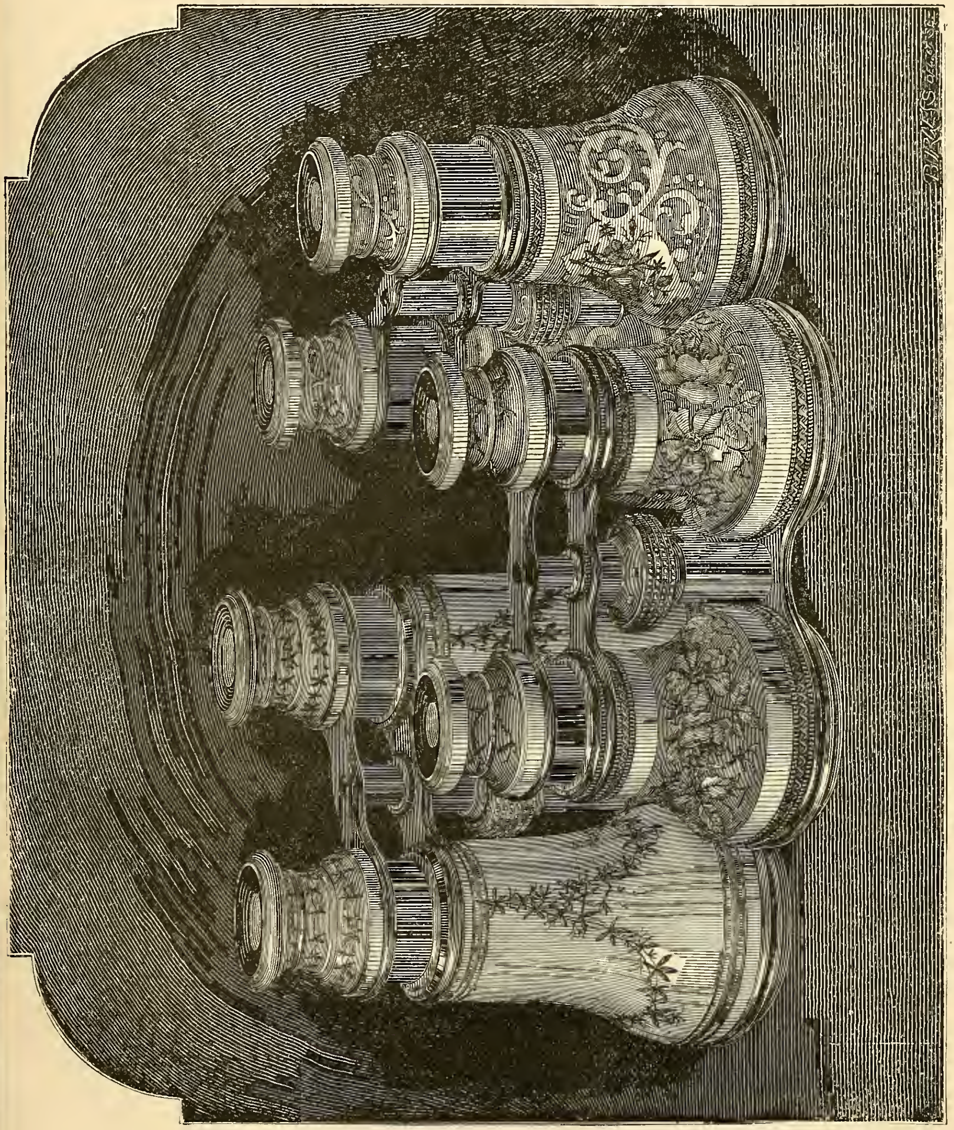
In the above Cabinets there are porcelain tablets let into the fronts of the drawers. The drawers are numbered and the specimens lie flat.

POSTAL BOXES FOR MICROSCOPIC OBJECTS.

No.		Price.
1482.	Card-board Boxes fitted with Racks to hold 12 objects	$ 15
1484.	Postal Boxes, to take 1 object	6
1485.	" " " 3 "	8
1486.	Postal Boxes, to take 6 objects	10
1487.	" " " 12 "	12
1488.	" " " 25 "	15

CASES FOR MICROSCOPIC OBJECTS.

1489. Portable Horizontal Slide Case, with 12 Trays, holding 12 dozen objects, lying flat, the same as in case No. 1471, with a substantial cover of bookbinder's cloth 4 00



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SUNDRY OPTICAL INSTRUMENTS.

Since writing our preface we have determined to insert in this Catalogue just enough matter of a more general character to convince our patrons that we are prepared to serve them in any way possible, and at the best market rates. While this is a great accommodation and saving to them, we will make it more so by allowing our "Outfit prices" and terms to include anything ordered through or from us.

ACHROMATIC MARINE AND FIELD GLASSES.

These Glasses are designated according to the diameter of the Object-glasses in French lines, as follows:

11 Lines	are	equal to	1 inch.
13 "	"	"	$1\frac{3}{16}$ inches.
15 "	"	"	$1\frac{5}{16}$ "
17 "	"	"	$1\frac{1}{2}$ "
19 "	"	"	$1\frac{11}{16}$ "
21 "	"	"	$1\frac{7}{8}$ "
24 "	"	"	$2\frac{1}{8}$ "
26 "	"	"	$2\frac{5}{16}$ "

They are all constructed with six lenses, unless the contrary is specially stated and are invariably well corrected and adapted to all visions.

Prices range from .... $8 00 to $30 00

ALUMINIUM FIELD OR MARINE GLASSES.

From .... 35 00 to 60 00

All kinds Opera Glasses, Lemare's and Bardou's included, prices ranging from .... 6 00 to 25 00

Aluminium Opera Glasses, from .... 20 00 to 35 00

ACHROMATIC SPY-GLASSES OR TELESCOPES.

From .... 3 00 to 40 00

ASTRONOMICAL TELESCOPES.

By BARDOU, PARIS, and R. & J. BECK, PHILADELPHIA and LONDON, from .... $60 00 to $2,400 00

SPHERICAL SPECTACLE LENSES.

Spherical, Cylindrical or Prismatic Lenses, of the *First Quality only*, fitted to frames at the following prices:

No.		PRICE.
2135.	Periscopic or Double Convex White Lenses, from 5 to 72 inches focus, per pair	$ 75
2136.	Periscopic or Double Convex White Lenses, from 1 to 4¾ inches focus, per pair	1 25
2137.	Double Convex White, Divided or Franklin Lenses, per pair	1 50
2138.	" " " Lenses, two foci on one glass, "	1 50
2139.	Periscopic or Double Convex Tinted Lenses, Blue, Pink, Green or Smoke, per pair	1 50
2140.	Periscopic or Double Concave White Lenses. from 5 to 72 inches focus, per pair	75
2141.	Periscopic or Double Concave White Lenses, from 1 to 4¾ inches focus, per pair	1 25
2142.	Periscopic or Double Concave Tinted Lenses, Blue, Pink, Green or Smoke, per pair	1 50
2143.	Plane, Blue, Green or Smoke-colored Glasses, per pair	1 00

CYLINDRICAL SPECTACLE LENSES.

2145.	Plano-Convex or Concave Cylindrical White Lenses, per pair	$2 00
2146.	" " " " " single lens	1 25
2147.	Sphero-Convex " " " " per pair	4 00
2148.	" " " " " single lens	2 50
2149.	Plano-Convex or Concave Cylindrical and Prismatic White Lenses, per pair	4 00
2150.	Plano-Convex or Concave Cylindrical and Prismatic White Lenses, single lens	2 50
2151.	Sphero-Convex or Concave Cylindrical and Prismatic White Lenses, per pair	5 50
2152.	Sphero-Convex or Concave Cylindrical and Prismatic White Lenses, single lens	3 00
2153.	Crossed Cylindrical Lenses, Convex or Concave, White, per pair	7 00
2154.	" " " " " " single lens,	4 00

PRISMATIC SPECTACLE LENSES.

2160.	Plane Prismatic Lenses, White, per pair	$2 00
2161.	" " " single prism	1 25
2162.	Sphero-Prismatic " " per pair	4 00
2163.	" " " single prism	2 50

PEBBLE SPECTACLE LENSES, ETC.

No.		Price.
2165.	Periscopic or Double Convex Pebble Lenses, per pair	$3 00
2166.	" " Concave " " "	3 00
2167.	A set of Colored Lenses to aid the designer in originating new shades and tints of colors, and to discover errors of the dyer, per set, with handles	5 00
	Per set, without handles	3 00
	Single Lenses, each, with handle	1 25
	" " " without "	75
2170.	Spectacle Case, Morocco, with tuck	20
2171.	" " " open end	20
2172.	" " Fine English Leather	75
2173.	" " Scotch Plaid Frog Mouth	50 to 1 50
2174.	" " German Silver, Plated	1 25 to 1 75
2175.	Velvet Chatelaine Case	1 00 to 3 00
2176.	Morocco " "	75 to 2 00
2180.	Eye-Glass Case, Morocco, open end	15
2181.	" " Finest Russia Leather	35
2182.	" Hooks, Gold	1 50 to 5 00
2183.	" " Gilt	25
2184.	" " Steel	15
2185.	" Chains, Gold, with Hook	4 00 to 6 50
2186.	" Guard, Pure Silk	10
2187.	" " Catgut	10

NICOL'S PRISMS.

2200.	Nicol's Prism of Iceland Spar, 8 millimetres across face	2 25
2201.	" " 9 " "	2 75
2202.	" " 10 " "	3 50
2203.	" " 11 " "	4 00
2204.	" " 12 " "	4 75
2205.	" " 14 " "	6 75
2206.	" " 16 " "	9 75
2207.	" " 20 " "	20 00

Larger sizes imported to order.

CLAUDE LORRAINE, OR LANDSCAPE MIRRORS.

Claude Lorraine, or Landscape Mirror. A pleasing and beautiful instrument, for viewing clouds, landscapes, etc. As the mirror condenses or diminishes the view into a true perspective effect, the instrument is invaluable to the artist, and a very desirable companion for tourists. Six sizes, as follows:

No.						Price.
2220.	Mirror, 6½ inches long by	5¼ inches wide, in strong Morocco case, each				$5 50
2221.	" 7½	" 5¼	"	"	"	6 00
2222.	" 7½	" 6¼	"	"	"	7 50
2223.	" 8½	" 6¼	"	"	"	9 00
2224.	" 8½	" 7½	"	"	"	10 00
2225.	" 9½	" 7½	"	"	"	11 00

HAND MIRRORS, IN BLACK WOOD FRAMES.

2230. Mirror Magnifying on one side, diminishing on the other, 6 inches diameter 5 00
2231. Mirror, Cylindrical (elongating and shortening), 6 inches diameter, 3 00
2232. " Multiplying (producing several images), 6 inches diameter, 5 00
2233. " Magnifying on one side, plane on the other, 3½ in. diameter, 1 75
2234. " " " " 5 " 2 50
2235. " " " " 6 " 3 00

HAND MIRRORS, IN FINE MAHOGANY FRAMES.

2238. Mirror, Magnifying on one side, diminishing on the other, 5 inches diameter 3 00
2239. Mirror, Magnifying on one side, diminishing on the other, 6 inches diameter 4 00

MAGIC LANTERNS.

In Japanned Tin, with Coal-Oil Lamps.

2245. Magic Lantern, 6 inches high, with 6 glass and 3 movable slides.. 5 00
2246. " 7 " " 6 " 3 " .. 6 00
2247. " 8 " " 6 " 3 " .. 7 50
2248. " 9 " " 6 " 3 " .. 9 00

KLAEGER INSECT PINS.

2250. The Genuine Klaeger Insect Pins, five sizes, per 100.......... 15
" 1000......... 1 25
2255. Zoetrope, or Wheel of Life 3 00

A mechanical and optical exemplification of the persistence of vision, and a valuable aid in illustrating the wonders of optics. The turning of the drum or cylinder brings into view the varying form or position of a figure in rapid succession, until they blend into a perfect image full of motion and natural action.

No.		Price.
2256.	Extra views for Zoetrope, per set of six	$1 00
2260.	PARLOR KALEIDOSCOPE, on Stand with Brass Front	2 00

CAMERA LUCIDA.

2265.	CAMERA LUCIDA, mounted on heavy brass base	7 50
2266.	CAMERA LUCIDA, with joint for inclination, and clamp for attaching to table	10 00
2267.	CAMERA LUCIDA, mounted with double joints for inclination, extending rod and two colored glasses for modifying the light, with clamps for attaching to table	17 50

The CAMERA LUCIDA is a most useful instrument for the Designer, Artist or Draughtsman, enabling him to draw very readily a landscape or any desired object correctly. Its use may be readily learned by observing the following directions :

The instrument being fixed to the table and paper on which the drawing is to be made, its stem should be inclined so as to bring the prism nearly over the centre of the paper, and the pin on which the prism turns placed truly horizontal.

The prism is next to be turned upon its pin, until the transparent rectangular face be placed opposite to the objects to be delineated, when the upper black surface of the eye-piece will be on the top of the instrument; and through the aperture in this the artist is to look perpendicularly downwards at his paper.

The black eye-piece is movable, and in ordinary circumstances is to be in such a position that the edge of the small transparent part at the back of the prism shall intercept about half the eye-hole. The artist then, looking through the eye-hole, directly downwards at his paper, should see the objects he wishes to draw, apparently distributed over the paper. For, since the eye is larger than the eye-hole, he sees through both halves of the hole at the same time without moving his head. He sees the paper through the nearer half, and sees the objects at the same time through the farther half, apparently in the same direction, by means of reflection, through the prism.

The position of the EYE-HOLE is the circumstance, above all others, necessary to be attended to in adjusting the *Camera Lucida* for use ; for, on the due position of this hole depends the possibility of seeing both the pencil and the objects distinctly at the same time.

If the eye-hole be moved, so that nearly the whole of its aperture be over the paper, and a very small portion over the prism, then the pencil and paper will be very distinctly seen ; but the objects to be delineated very dimly. If, on the other hand, the aperture be mostly over the prism, and but a small portion over the paper, then the objects will be seen distinctly, but the pencil and paper will be very faint. But there will always be an intermediate position (varying according as the objects or the paper happen to be most illuminated) in which both will be sufficiently visible for the purpose of delineation, though not quite so clear as to the naked eye. This intermediate position is easily found with a little practice.

The farther the prism is removed from the paper, that is, the longer the stem is drawn out, the larger the objects will be represented in the drawing, and accordingly the less extensive the view.

WINDOW MIRRORS.

No.		Price.
2275.	Patent Window Mirrors, complete for putting up	$3 00

The Window Mirror, or "Bo Peep," enables any one at an upper window to observe who may be at the front-door, whilst remaining himself concealed, affording also a panoramic view of the street in both directions for several blocks.

BECK'S NEW PATENT CLINICAL THERMOMETERS.

We have given great attention to the manufacture of these instruments, which are useless if not entirely accurate, and are certain that in all respects those we now offer to the profession are superior to any heretofore sold in the United States. One of the greatest imperfections in all others has been the obliteration of the scales by the action of perspiration, etc. This we have entirely obviated by using a black enamel in the scales and figures, which we guarantee indestructible, except by violence; and by a constriction (patented) in the tube, the loss of the index is rendered impossible. Each thermometer is guaranteed to be correct; but, if desired, we can furnish them with the Kew verification for an addditional charge of 50 cents each.—(*R. & J. Beck's Catalogue.*) The prices are as follows:

3½ inch in Ebony or Boxwood case	$2 75
4 " " " "	3 00
5 " " " "	3 50
6 " " " "	4 00
5½-inch Patent Surface Thermometer, exceedingly sensitive, in fine snap Morocco case	5 00
Steward's Patent Insulated, Surface Clinical Thermometer, in Morocco case	20 00
Dr. Mattison's Patent Insulated, Surface Clinical Thermometer, in snap Morocco case	6 00
Vaginal Clinical Thermometer, 8 inches in length, with tube protected by a Nickel Silver Sheath, in fine Morocco case	7 50

MATHEMATICAL INSTRUMENTS.

This Catalogue comprises a very complete assortment of Mathematical Instruments, containing:

Swiss Instruments, in 2 Qualities,
Swiss " with Pivot Joint,
English "
German "
French "

of the very best quality and provided with the latest and best improvements.

The needle-points of the best qualities have in place of the common needle a shouldered needle, which forms a much better and more reliable support.

The Swiss Instruments specified—from No. 3125–3190–3216—are superior to all others. Having a more graceful form and being hand-finished, they do not offend the eye with glossy or burnished surfaces which are easily produced by machinery, but are a sign of inferiority.

The German Instruments are well made and of good quality; they are mostly used in schools and by apprentices, and will even give good satisfaction to professional draughtsmen and designers.

The French Instruments, of which we specify a complete assortment in cases as well as of separate pieces, recommend themselves on account of their great cheapness and comparatively satisfactory workmanship. For scholars and apprentices they will be found good enough, but they will not be sufficient for the use of experts and professionals.

Repairing of Instruments done at moderate charges.

SUPERIOR SWISS INSTRUMENTS.

OF BEST GERMAN SILVER AND ENGLISH STEEL.

No.		Price.
3125.	Plain Dividers, 3½ inch, each	$ 1 75
3126.	" " with handle, 3½ inch, each	2 25
3127.	Compasses, 3½ inch, with Pen, Pencil and Needle Points	6 00
3128.	" 3½ " " fixed Needle Point, Pen and Pencil Points,	5 25
3129.	" 3½ " " fixed Needle and Pen Points (BowPen)	3 50
3130.	" 3½ " " fixed Needle and Pencil Points (BowPencil)	3 50
3131.	Plain Dividers, 5 inch, each	2 20
3132.	" 6 "	2 75
3133–1.	Hairspring Dividers, 3 inch, with handle, each	2 60
3133.	" 5 inch, each	3 00
3133–2.	" 6 inch, each	3 15
3134.	Compasses, 5½ inch, with fixed Needle Point, Pen, Pencil Points and Lengthening Bar, each	7 00
3134½.	Compasses, 4½ inch, with fixed Needle Point, Steel Pen, Pencil Points and Lengthening Bar, each	7 25
3135.	Compasses, 6 inch, with Pen, Pencil, Needle Points and Lengthening Bar, each	8 00

No.		Price.
3136.	Compasses, 6½ inch, with joint in each leg, Pen, Pencil, Needle Points and Lengthening Bar..................................	$9 25
3137.	Compasses, 7 inch, with joint in each leg, Pen, Pencil, Needle Points, Lengthening Bar and Dotting Pen......................	10 75
3137–1.	Compasses, 7½ inch, with joint in each leg, Pen, Pencil, Needle Points, Lengthening Bar and Dotting Pen with 6 wheels.........	12 00
3138.	Pocket Dividers, with sheath, 5 inch, each............................	3 00
3139.	Pillar Compasses, with handles, Pen and Pencil Points to draw out, forming small Bows if required, each....	9 50
3139–1.	Pillar Compasses, with 2 Lengthening Bars to strike larger circles, each	11 50
3140.	Pocket Compasses, with folding Points, each..........................	8 75
3141.	Triangular Compasses, for taking off three points, each............	5 00
3141-1.	Triangular Compasses, with movable Bar, each..................	5 75
3142.	Whole and Half Dividers, 7¼ inch, each............................	4 00
3150.	Minute Steelspring Dividers and Bows, 3 in set, 2½ inch, set....	8 25
3151.	Steelspring Bow Dividers, with Ivory Handle 3 " each...	2 20
3152.	" Bow Pen, " 3 " "	2 50
3153.	" Bow Pencil " 3 " "	2 50
3154.	" Bow Pen, Needle Point, Ivory Handle, 3 " "	2 85
3155.	' Bow Pencil " " 3 " "	2 85
3156.	" Bow Dividers, with Ivory Handle 3½ " "	2 60
3157.	" Bow Pen, Needle Point, Ivory Handle, 3½ " "	3 00
3158.	" Bow Pencil " " 3½ " "	3 00
3156.	Large Steelspring, Bow Dividers, " 4¾ " "	2 75
3157.	" Bow Pen, with Needle Point, Ivory Handle, 4¾ inch, each	3 25
3158.	Large Steelspring Bow Pencil, with Needle Point, Ivory Handle, 4¾ inch, each	3 25
	Morocco Cases for sets of 3151, 3152, 3153 or 3151, 3154, 3155, each......	75
	" for sets of 3156, 3157, 3158 each	1 00
	" for sets of 3156L, 3157L, 3158L, each...	1 25
3164.	Drawing Pen with Ebony Handle, 4½ inch, each........................	1 00
3165.	" " 5 "	1 10
3166.	" with joint, Ivory Handle, 4 inch, each...	1 40
3167.	" with joint and pin, Ivory Handle, 4¾ inch, each......	1 60
3168.	" " " 5½ "	1 80
3168–2.	" " " and German Silver blades, 5½ inch, each..	1 80
3169	Drawing Pen with German Silver blades, 6½ inch, each............	2 00
3170.	Border Pen for broad lines, 6½ inch, each...	3 00
3170–2.	" " improved, 6½ inch, each................	3 50

Border Pen No. 3170–2 may also be used as Railroad Pen by filling only the two outer pair of blades with ink.

3171.	Curve Pen, 4½ inch, each	1 50
3171½.	Railroad Pencil, each..	3 25
3172.	Railroad Pen with Ivory Handle, 5½ inch, each	3 50
3173.	Railroad Pen, K. & E.'s improved, 5½ inch, each..................	3 75

The improvement of this instrument consists in having both pens bent in the same direction, and therefore lines can be drawn against straight edges and rules as perfect as with a ruling pen.

No.		Price.
3174.	Dotting Pen with 6 wheels, 6 inch, each	$3 75
3175.	Dotting Pen with 6 wheels, improved, 6 inch, each	4 25

The improved Dotting Pen No. 3175 is highly prized, as it entirely prevents blotting. The reservoir after being filled is closed, and through a minute opening allows no more ink to the dotting wheel than is actually needed.

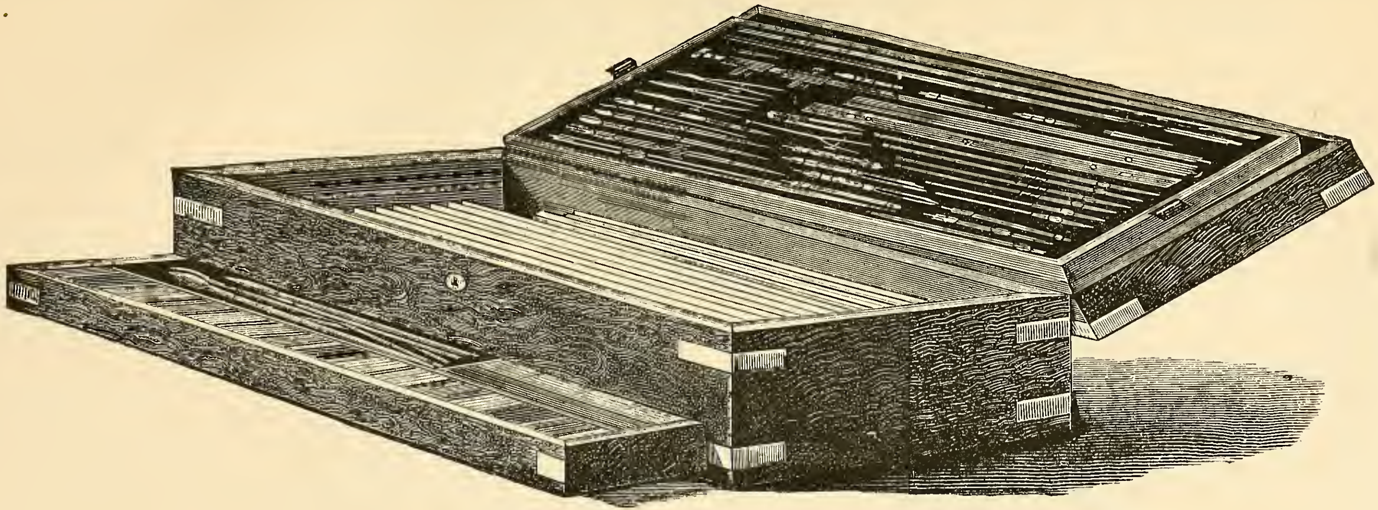
3176.	Opisometer for measuring curved lines, each	1 80
3177.	Tracer, each	1 35
3178.	Pricker, each	1 75
3180.	Swiss Instruments in Morocco Cases, containing Nos. 3126, 3128 and 3166	10 00
3180–1.	Swiss Instruments in Morocco Cases, containing Nos. 3133, 3132–4, 3166 and 3168	15 00

3180–2, 3180–3, 3180–4 are larger sizes.

3181 to 3187 inclusive are Swiss Instruments in Rosewood Cases, with fine Velvet .... $25 00 to 65 00

3181 to 3187 in Black Walnut (oiled) cases, each $2 to $4 less than Rosewood.

Drawing Pens carefully set and sharpened, each 20 to 25 cents.



No. 3189.

No. 3188. Fine polished Rosewood Case with Lock and Tray (20 important pieces), each 92 00

3189. Fine polished Rosewood Case with German Silver Straps and Corners, Lock, Tray and Drawer, containing the same instruments as No. 3188; in central portion 6 Hard Rubber Chain and 6 Offset Scales or 8 Architect Scales, Ivory Rectangular Protractor, German Silver Protractor, 2 dozen German Silver Tacks, 2 Horncentres with German Silver edge; Drawer containing 12 Water Colors, India Ink, 12 assorted Brushes, Ink Slab, Color Saucers, 2 Rubber Triangles, 2 Rubber Curves, each 166 00

Other Cases fitted up to order, with such instruments as may be selected from our Catalogue.

SWISS INSTRUMENTS

OF BEST GERMAN SILVER AND ENGLISH STEEL WITH PATENT PIVOT JOINT.

No.		Price.
3199.	Hairspring Dividers, 3½ inch, each	3 00
3200.	Dividers, 3½ inch, each	2 00
3201.	Compasses, 3½ inch, with Pen, Pencil and Needle Points, each	7 00
3202.	Compasses, 3½ inch, with fixed Needle Point, Pen and Pencil Points, each	6 00
3203.	Compasses, 3½ inch, with fixed Needle and Pen Points (Bow Pens), each	4 75
3204.	Compasses, 3½ inch, with fixed Needle and Pencil Points (Bow Pencil)	4 25
3205.	Dividers, 5 inch	2 75
3205. I.	" 6 "	3 25
3206.	Hairspring Dividers, 5 inch	3 50
3206. I.	" " 6 "	4 00
3207.	Compasses, 5 inch, with fixed Needle Point, Pen, Pencil, Points and Lengthening Bar, each	7 50
3208.	Compasses, 6 inch, with Pen, Pencil, Needle Points and Lengthening Bar	8 50
3213.	Steel-spring Dividers, with German Silver Handle, 3½ inch	2 20
3214.	Steel-spring Bow Pen, with German Silver Handle and Needle Point, 3½ inch	2 85
3215.	Steel-spring Bow Pencil and Needle Point, 3½ inch	2 85

SWISS INSTRUMENTS WITH PIVOT JOINT.

IN MOROCCO POCKET-CASES.

3216–1,	containing 3200, 3201, 3166	12 00
3216–2,	" 3199, 3203, 3204, 3166	15 00
3216–3,	" 3200, 3202, 3150, 3166, 3168	22 00
3216½4,	" 3202, 3206, 3207, 3166, 3168	23 00

To complete a set of the above Instruments we recommend our regular Swiss from Nos. 3125–3178, as they match them in style and finish.

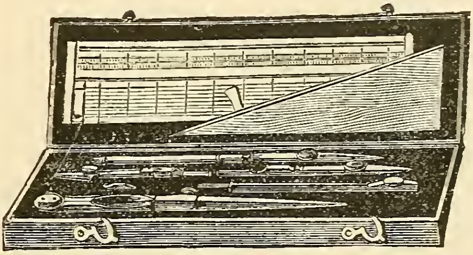
Nos. 3220 to 3239 are **English Instruments,** German Silver, fine finish, double sector-joint.

Nos. 3250 to 3294 are **German Instruments,** German Silver, best Steel Points, highly finished.

CASES OF GERMAN SILVER INSTRUMENTS.

MOROCCO CASES, LINED WITH BLACK VELVET.

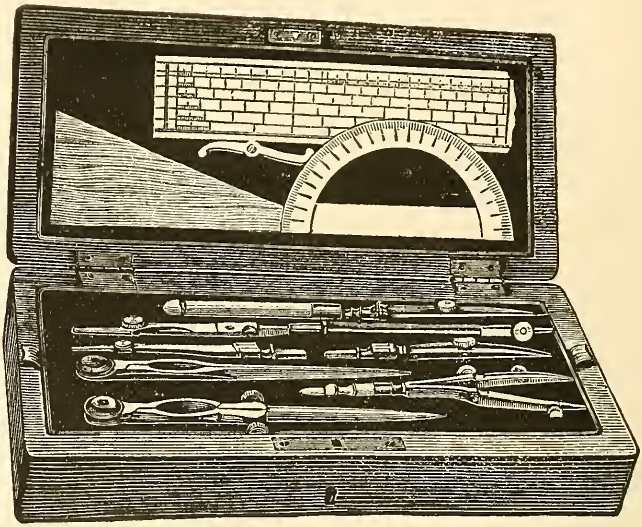
No.		Price.
3300,	containing 1 Compass, $3\frac{1}{2}$ inch, with Pen, Pencil and Needle Points, 1 Drawing Pen, each	$3 50



No. 3301.

3301,	containing 1 Compass, $5\frac{1}{2}$ inch, with Pen, Pencil Points and Lengthening Bar, 1 Drawing Pen, 1 boxwood Scale, 1 Triangle, each	3 50
$3301\frac{1}{2}$,	containing 1 Compass, $5\frac{1}{2}$ inch, with Pen and Pencil Points, 1 Dividers, 5 inch, 1 Drawing Pen, 1 boxwood Scale, 1 Triangle, each.	4 00
3302,	containing 1 Compass, $5\frac{1}{2}$ inch, with Pen, Pencil, Needle Points and Lengthening Bar, 1 Drawing Pen, 1 boxwood Scale, 1 Triangle, each	5 00
$3302\frac{1}{2}$,	containing 1 Compass, $5\frac{1}{2}$ inch, with Pen, Pencil and Needle Points, 1 Dividers, 5 inch, 1 Drawing Pen, 1 boxwood Scale, 1 Triangle, each	5 50
3303,	containing 1 Compass, $5\frac{1}{2}$ inch, with Pen, Pencil, Needle Points, and Lengthening Bar, 1 Dividers, 5 inch, 1 Drawing Pen, 1 boxwood Scale, 1 Triangle, each	6 00
3304,	containing 1 Compass, $5\frac{1}{2}$ inch, with Pen, Pencil, Needle Points and Lengthening Bar, 1 Dividers, 5 inch, 1 Drawing Pen, 1 Steel Spring Bow Pen with Needle Point, 1 Semi-circle Protractor, 1 boxwood Scale, 1 Triangle, each	8 00
3305,	containing 1 Compass, $5\frac{1}{2}$ inch, with Pen, Pencil, Needle Points and Lengthening Bar, 1 Hairspring Dividers, 5 inch, 1 Compass, $3\frac{1}{2}$ inch, with Pen, Pencil and Needle Points, 1 Drawing Pen with Pin, 6 inch, 1 Semicircular Protractor, 1 Boxwood Scale, 1 Triangle, each	11 00

POLISHED BLACK WALNUT CASES WITH LOCK AND TRAY.

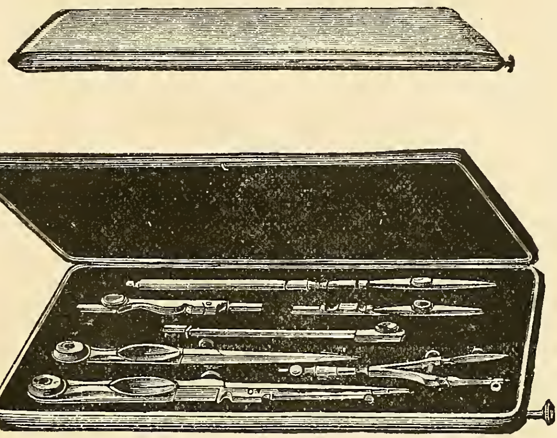


No. 3308.

No.		Price.
3308,	containing 1 Compass, 5½ inch, with Pen, Pencil, Needle Points and Lengthening Bar, 1 Dividers, 5 inch, 1 Drawing Pen with Pin, 1 Steel Spring Bow Pen with Needle Point, I Semicircular Protractor, 1 boxwood Scale, 1 Triangle, each	$10 00
3309.	containing I Compass, 5½ inch, with Pen, Pencil, Needle Points and Lengthening Bar, 1 Dividers, 5 inch, 1 Compass, 3½ inch, with Pen, Pencil and Needle Points, 1 Drawing Pen, 6 inch, with Pin, 1 Semicircular Protractor, 1 boxwood Scale, 1 Triangle, each	11 50
3310,	containing 1 Compass, 5½ inch, with Pen, Pencil, Needle Points and Lengthening Bar, I Dividers, 5 inch, 1 Compass, 3½ inch, with Pen, Pencil, Needle Points, 1 Steel Spring Bow Pen with Needle Point, 1 Drawing Pen, 4 inch, 1 Drawing Pen, 6 inch, with Pin, Semicircular Protractor, 1 boxwood Scale, 1 Triangle, each............	15 00
3311,	containing the same as No. 3310, 1 Hairspring Dividers, 5 inch, instead of Plain Dividers, 5 inch, and 1 Steel Spring Dividers, I Steel Spring Bow Pencil..	19 00

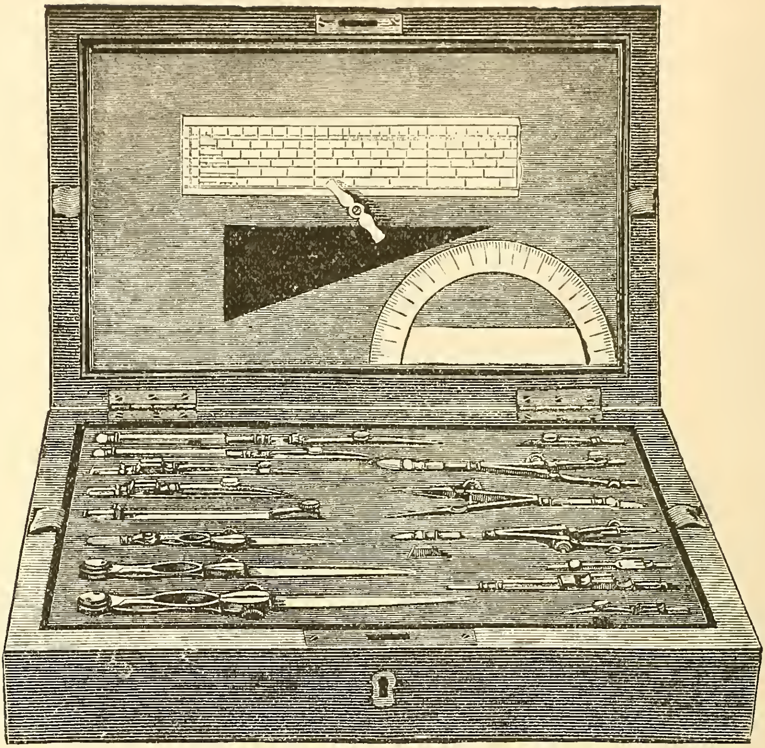
CASES OF GERMAN SILVER INSTRUMENTS.

VERY BEST QUALITY—FINE MOROCCO POCKET CASE, LINED WITH PURPLE VELVET.



No. 3315.

No.		Price.
3314,	containing 1 Compass, 3½ inch, with Pen, Pencil and Needle Points, 1 Drawing Pen, 4 inch, each	$5 00
3315,	containing I Compass, 4½ inch, with fixed Needle Point, Pen and Pencil Points and Lengthening Bar, 1 Divider, 4½ inch, 1 Steel Spring Bow Pen, with Needle Point, 1 Drawing Pen, with Pin, each,	8 50
3316.	Larger size, containing Nos. 3255, 3259, 3275, each	8 25
3317,	containing Nos. 3255, 3259, 3251, 3275, each	11 50
3318,	" " 3255, 3259, 3251, 3272, 3275, 3283, each	14 00
3319.	" " 3257, 3259, 3251, 3272, 3275, 3282, 3283, 3284, each,	18 00
3316–3319,	containing Scale and Rubber Triangle, extra	75
3322,	containing Nos. 3255, 3259, 3275, 3283, 1 German Silver Protractor, 1 Ivory Scale, 1 Rubber Triangle, each	12 00
3323,	containing Nos. 3255, 3259, 3251, 3275, 1 German Silver Protractor, 1 Ivory Scale, 1 Rubber Triangle, each	14 00



No. 3311–3325.

No.	Price.
3324, containing Nos. 3255, 3259, 3251, 3283, 3272, 3275, 1 German Silver Protractor, 1 Ivory Scale, 1 Rubber Triangle, each	17 50
3325, containing Nos. 3257, 3259, 3251, 3272, 3275, 3282, 3283, 3284, 1 German Silver Protractor, 1 Ivory Scale, 1 Rubber Triangle, each,	21 75
3326, containing 3255, 3257, 3259, 3251, 3272, 3275, 3281, 3264, 3282, 3283, 3284, 1 German Silver Protractor, 1 Ivory Scale, 1 Rubber Triangle, each	32 00

Larger Cases to contain any of the Instruments specified in this Catalogue made up to order.

FRENCH INSTRUMENTS,

OF BRASS AND GERMAN SILVER IN CASES.

No.		Price
3339.	Mahogany Case, containing 5 pieces, Brass, 1 pair Compasses, 4½ inch, with Pen and Pencil Points, 1 Key, each	60
3340.	Mahogany Case, containing 6 pieces, Brass, 1 pair Compasses, 4½ inch, with Pen and Pencil Points, 1 Crayon-holder, 1 Key, 1 Rule, each	65
3341.	Mahogany Case, containing 8 pieces, Brass, 1 pair Compasses, 4½ inch, with Pen, Pencil Points and Lengthening Bar, 1 Crayon-holder, 1 Protractor, 1 Key, 1 Rule, each	80
3342.	Mahogany Case, containing 9 pieces, Brass, 1 pair Compasses, 4½ inch, with Pen, Pencil Points and Lengthening Bar, 1 Drawing Pen, 1 Crayon-holder, 1 Protractor, 1 Key, 1 Rule, each	95
3344.	Rosewood Case, containing 10 pieces, German Silver, 1 pair Compasses, 4½ inch, with Pen, Pencil Points and Lengthening Bar, 1 pair Dividers, 3½ inch, 1 Drawing Pen, 1 Protractor, 1 Crayon-holder, 1 Key, 1 Rule, each	2 75
3345.	Mahogany Case, containing 10 pieces, Brass, 1 pair Compasses, 4½ inch, with Pen, Pencil Points and Lengthening Bar, 1 pair Dividers, 3½ inch, 1 Drawing Pen, 1 Protractor, 1 Crayon-holder, 1 Key, 1 Rule, each	1 05
3346.	Mahogany Case, the same as No. 3345, Compasses 5½ inch, Dividers 4½ inch, each	1 30
3346–2.	Mahogany Case, the same as No. 3345, Compasses 6½ inch, Dividers 4½ inch, each	1 60
3346–3.	Rosewood Case, the same as No. 3346, German Silver	3 25
3347.	Mahogany Case, containing 12 pieces, Brass, 1 pair Compasses, 4½ inch, with Pen, Pencil Points and Lengthening Bar, 1 pair Dividers, 3½ inch, 1 Bow Pen with Pencil Point, 1 Drawing Pen, 1 Protractor, 1 Key, 1 Rule, each	1 50
3348.	Mahogany Case, containing 12 pieces, Brass, the same as No. 3347, but Compasses 5½ and 4½ inch long, each	1 85
3349.	Rosewood Case, containing 12 pieces, Brass, the same as No. 3348, each	2 25
3350.	Rosewood Case, with Lock and Tray, containing 12 pieces, Brass, the same as No. 3348, each	2 60
3351.	Rosewood Case, with Lock and Tray, containing 12 pieces, German Silver, the same as No. 3348, each	4 60
3352.	Rosewood Case, with Lock and Tray, containing 12 pieces, Brass, the same as No. 3350, but Compasses 6½ and 5½ inch long, each	3 00
3355.	Rosewood Case, with Lock and Tray, containing 16 pieces, Brass, 1 pair Compasses, 6½ inch, with Pen, Pencil Points and Lengthening Bar, 1 pair Compasses, 3½ inch, with Pen and Pencil Point, 1 pair Dividers, 4½ inch, 1 Bow Pen with Pencil Point, 1 Drawing Pen, 2 Protractors, 1 Key, 1 Rule, each	3 40
3356.	Rosewood Case, with Lock and Tray, containing 16 pieces, Brass, the same as No. 3355. The Compasses with Needle Points, each,	4 20

No.		Price.
3357.	Rosewood Case, with Lock and Tray, containing 16 pieces, German Silver, the same as No. 3355, each........	$7 00
3358.	Rosewood Case, with Lock and Tray, containing 16 pieces, German Silver, the same as No. 3357. The Compasses with Needle Points, each............	7 50
3355P.	Rosewood Case, with Lock and Tray, containing 17 pieces, Brass, 1 pair Compasses, 6½ inch, with Pen, Pencil Points and Lengthening Bar, 1 pair Compasses, 3½ inch, with Pen and Pencil Points, 1 pair dividers, 4½ inch, 1 Bow Pen with Pencil Point, 1 Proportional Divider, 1 Drawing Pen, 2 Protractors, 1 Key, 1 Rule, each.......	6 25
3357P.	Rosewood Case, with Lock and Tray, containing 17 pieces, German Silver, the same as No. 3355P, each..............	9 00
3362.	Rosewood Case, with Lock and Tray, containing 14 pieces, *Brass*, 1 pair Compasses, with Needle Point, 6½ inch, with Pen, Pencil Points and Lengthening Bar, 1 pair Compasses with Needle Point, 4½ inch, Pen and Pencil Points, 1 pair Dividers, 4½ inch, 1 Spring Bow Pen, 1 Drawing Pen, 2 Protractors, 1 Rule, 1 Key, each....	4 60
3363.	Rosewood Case, with Lock and Tray, containing 14 pieces, *German Silver*, the same as No. 3362, each.........	7 25
3364.	Rosewood Case, with Lock and Tray, containing 14 Pieces, *Brass*, the same as No. 3362, but with Patent Pencil Points, each... ..	5 30
3365.	Rosewood Case, with Lock and Tray, containing 15 Pieces, *Brass*, the same as No. 3366, but with Patent Pencil Points, each......	7 50
3366.	Rosewood Case, with Lock and Tray, containing 15 pieces, *Brass*, 1 pair Compasses with Needle Point, 6½ inch, with Pen, Pencil Points and Lengthening Bar, 1 pair Compasses with Needle Point, 4½ inch, with Pen and Pencil Points, 1 pair Dividers, 4½ inch, 1 Spring Bow Pen, 1 Proportional Dividers, 1 Drawing Pen, I Protractor, 1 Key, each................	7 00
3367.	Rosewood Case, with Lock and Tray, containing 15 pieces, *German Silver*, the same as No. 3366, each...........................	9 75
3368.	Rosewood Case, with Lock and Tray, containing 15 Pieces, *German Silver*, the same as No. 3367, but with Patent Pencil Points, each,	10 60
3369.	Rosewood Case, with Lock and Tray, containing 19 pieces, the same as No. 3368, and with Beam Compasses No. 3390, each........	16 00
3370.	Rosewood Case, inlaid, with Lock and Tray, containing 18 Pieces, *German Silver*, 1 pair Compasses with Needle Point, 6½ inch, with Pen, Patent Pencil Points and Lengthening Bar, 1 pair Compasses, 4½ inch, with handle, with Needle Point Pen and Patent Pencil Points, 1 pair Dividers, 4½ inch, 1 Spring Bow Pen, 1 Proportional Dividers, 3 Drawing Pens, 2 Protractors, 1 8-inch Ivory Rule, 1 Key, each........................	20 00
3371.	Rosewood Case, inlaid, with Lock and Tray, containing 22 pieces, *German Silver*, 1 pair Compasses with Needle Point, 6½ inch, with Pen, Patent Pencil Points and Lengthening Bar, 1 pair Compasses, 4½ inch, with handle, with Needle Point, Pen and Patent Pencil Points, 1 pair Dividers, 4½ inch, 1 Proportional Dividers, 1 Steel Spring Dividers, 1 Steel Spring Bow Pen, 1 Steel Spring	

No.		Price.
	Bow Pencil, 3 Drawing Pens, 1 8-inch Ivory Rule, 2 Protractors, 1 Key, 2 Triangles, 1 Curve, each	$24 50
3372.	Rosewood Case, inlaid, with Lock and Tray, containing 26 Pieces, *German Silver*, the same as No. 3371, but with Beam Compasses, each	32 00

Planimeters, Pantographs, Chartometers, Section Liners, Excentrolineads, Paper, Boxwood and Ivory Scales, and Protractors, in great variety of styles and prices.

3406.	Templet Odontograph, for describing Teeth of Gear Wheels, a valuable Instrument for Millwrights, Machinists, Pattern Makers, etc., with full description, in case	$3 00
	(Awarded a Medal at the Centennial Exhibition.)	
	Illustrated Practical Treatise on the above Odontograph by Prof. S. W. Robinson	50
3409–1.	Brass Trammel Heads, with Pencil Holder, 4 inch, each	1 25
3409–2.	" " with Pencil Holder, 5 inch, each	1 75
3409–3.	" " " " " 5½ " "	2 20
3416.	Handy Paper Cutter, *Brass*, each	50
3416–1.	" " " *Nickel-plated*, each	65.

This little Instrument is of important service to Draughtsmen for cutting drawings from the board; also, for cutting any kind of paper or bristol board. It is slid along the ruler or T square without injuring the edge, as is done by using a common knife. The cutter is adjusted by the side screw to cut only the thickness of the paper without striking the drawing board.

Measuring Tapes, Linen and Metalic, from 3 feet to 100 feet.

Parallel Rules, Straight Edges.

Perspective Lineads, T Squares.

Triangles, Curves, etc., from the largest and best manufactories.

HARD RUBBER DRAWING TOOLS,

MANUFACTURED BY KEUFFEL & ESSER.

Awarded with a Prize Medal and Diploma at the Thirty-ninth Exhibition of the American Institute.

All Tools of Hard Rubber are highly recommended. Their superiority over others is proved and recognized by the best authorities. They are annealed and consequently not affected by changes of temperature.

The Triangles and Curves are of the utmost durability in comparison with those made of wood, which either break or get loose at the joints.

The density of the Rubber permits a very high finish on the edges equal to metal, which is a great advantage to the Angles, Curves, Rules and T Squares.

The Hard Rubber Scales, to which we call the attention, will give the greatest satisfaction. They are especially adapted for use in more or less dark offices and by gaslight, and will in every case and under all conditions be found to be a great success, as they do not fatigue the eye.

DRAWING TABLES.

No.		Price.
3985.	Drawing Table, on Iron Stand with adjustable Board, suitable for office and private use, plain ash Board 20½x24 inch, each........	$9 00
3986.	Drawing Table, on Iron Stand with shelf......................	10 50
3987.	Drawing Table, with Black Walnut Board 22x25½ with shelf, each,	12 00
3988.	Drawing Table, with Black Walnut Board and Drawers, on castors, each	14 00
3989.	Drawing Table with Black Walnut Board with Drawers and long set screw, each..	15 00
3989–1.	Drawing Table, with Black Walnut Board with Drawers and long set screw, finely ornamented, gilt, each........................	18 00

DRAWING BOARDS.

Our Drawing Boards are made with great care of narrow strips of best selected thoroughly seasoned pine.

3390.	Drawing Board, pine wood, hard wood ledges, screwed to the back, the screws run in slots to allow free contraction or expansion, as described at No. 4009, 16x21, each	1 50
3991.	20x26, each...	2 20
3992.	23x31, "	3 50
3993.	27x34, "	4 25
3994.	31x42, "	5 50
3995.	33x55, "	9 00
4000.	Drawing Board, pine wood, clamped, 12x17 inch, each..........	75
4001.	" " " 15x21 "	1 20
4002.	" " " 20x26 "	1 50
4003.	" " hard wood ledges, dovetailed in, 23x31 inch, each	3 00
4004.	Drawing Board, pine wood, hard wood ledges, dovetailed in, 27x34 inch, each..	3 75
4005.	Drawing Board, pine wood, hard wood ledges, dovetailed in, 31x42 inch, each	4 50
4006.	Drawing Board, pine wood, hard wood ledges, dovetailed in, 33x55 inch, each..	8 00
4007.	Drawing Board, pine wood, hard wood ledges, 16x21 inch, each....	3 00
4008.	" " " 20x26 "	4 50
4009.	" " " 23x31 "	6 00
4010.	" " " 31x42 "	8 50
4011.	" " " 33x55 " ...	12 00

This Drawing Board is the best and deserves recommendation, as it is the only one which possesses the qualities a good and true board should have. It is made of pine wood, glued up to the required width, with the heart side of each piece of wood to the surface. A pair of hard wood ledges are screwed to the back, the screws pass through the ledges in oblong slots, bushed with brass, which fit closely

under the heads and yet allow the screws to move freely when drawn by the contraction of the board. To give the ledges power to resist the tendency of the surface to warp, a series of grooves are sunk in half the thickness of the board over the entire back. These grooves take the transverse strength out of the wood to allow it to be controlled by the ledges, leaving at the same time the longitudinal strength of the wood nearly unimpaired.

To make the two working edges perfectly smooth, allowing an easy movement with the square, a slip of hard wood is let into the end of the board. The slip is afterwards sawn apart at about every inch to admit contraction.

No.		Price.
4012.	Drawing Board, pine wood, black walnut frame, size of board without frame, 12½x16 inch, each	2 50
4013.	Drawing Board, pine wood, black walnut frame, size of board without frame 14x19 inch, each	3 00
4014.	Drawing Board, pine wood, black walnut frame, size of board without frame 16x21 inch, each	3 50
4015.	Drawing Board, pine wood, black walnut frame, size of board without frame 18x26 inch, each	5 00
4016.	Drawing Board, pine wood, black walnut frame, size of board without frame 21x29 inch, each	6 00
4017.	Trestles made of well seasoned pine, 36 inch high, 46 inch long. For boards 31x42 or 33x55 inch, each	7 50
4031.	Tack-lifter (patented February 27, 1877,) Brass, Nickel plated, each,	25

A handy and simple instrument to extract thumb tacks from the drawing board. The end of the lifter is placed under the head of the tack and takes it out without bending the point or wrenching off the head, as is done by using a knife.

The handle of this Instrument is a Paper-knife, and is handy for removing drawings which have been glued to the drawing-board, etc.

DRAWING PINS OR TACKS.

4018.	Brass tacks, steel points, $\frac{3}{8}$ inch diameter, per dozen	15
4019.	Solid steel tacks, $\frac{5}{16}$ " "	25
4020.	Solid steel tacks, fine, $\frac{5}{16}$ " "	80
4021.	German Silver, steel points, screwed in and riveted, round head, $\frac{5}{16}$ inch diameter, per dozen	60
4022.	German Silver, steel points, screwed in and riveted, round head, $\frac{3}{8}$ inch diameter, per dozen	65
4023.	German Silver, steel points, screwed in and riveted, round head, $\frac{7}{16}$ inch diameter, per dozen	70
4024.	German Silver, steel points, screwed in and riveted, round head, $\frac{1}{2}$ inch diameter, per dozen	80
4025.	German Silver, steel points, screwed in and riveted, round head, $\frac{9}{16}$ inch diameter, per dozen	90
4025½.	German Silver, steel points, screwed in and riveted, round head, $\frac{5}{8}$ inch diameter, per dozen	1 00
4026.	German Silver, steel points, screwed in and riveted, beveled head, $\frac{3}{8}$ inch diameter, per dozen	65

No.		Price.
4027.	German Silver, steel points, screwed in and riveted, beveled head, $\frac{7}{16}$ inch diameter, per dozen	70
4028.	German Silver, steel points, screwed in and riveted, beveled head, $\frac{1}{2}$ inch diameter, per dozen	80
4028¼.	German Silver, steel points, screwed in and riveted, beveled head, $\frac{9}{16}$ inch diameter, per dozen	90
4028½.	German Silver, steel points, screwed in and riveted, beveled head, $\frac{5}{8}$ inch diameter, per dozen	1 00

Drawing Pins or Tacks, German Silver, steel points riveted, 2d Quality, round

head Nos.	1	2	3	4	5	5½	
	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	inch diameter.
Per dozen, $	.30	35	40	45	50	55	
Beveled head, Nos.	6	7	8	9	10		
	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$		inch diameter.
Per dozen, $	.35	40	45	50	55		

Drawing Pins or Tacks, Brass, steel points riveted, 2d Quality, round head

Nos.	0	1B	2B	3B	4B	
	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	inch diameter.
Per dozen, $	.15	20	25	30	35	
Beveled head, Nos.	6B	7B	8B			
	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$			inch diameter.
Per dozen, $	.25	30	35			

4029.	Horncentre plain, $\frac{1}{2}$ inch diameter, each	15
4030.	Horncentre with German Silver edge, $\frac{5}{8}$ inch diameter, each	50

GERMAN WATER COLORS,

FOR ARCHITECTS, MECHANICAL AND CIVIL ENGINEERS AND MACHINISTS.

The principal advantage of these colors consists in a series of tints, ready mixed for all technical purposes, enabling draughtsmen to apply the same tint without the difficult and and laborious process of mixing the colors.

The collections below show boxes arranged with the colors required by Architects, Machinists, Civil Engineers and Mechanical Draughtsmen, the value of which we feel assured will soon be appreciated. We have no doubt that these colors will receive the well deserved credit they have for many years enjoyed abroad.

GERMAN COLORS.

IN POLISHED SLIDE-LID BOXES.

4091.	For Architects, containing 12 colors, Nos. 105, 109, 116, 117, 121, 122, 131, 136, 142, 152, 155, 171, each	$3 25
4092.	For Architects, containing 18 colors, Nos. 100, 105, 109, 110, 116, 117, 121 122, 129, 131, 133, 135, 136, 142, 152, 155, 161, 171...	4 50

No.		Price.
4093.	For Architects, containing 24 colors, Nos. 100, 105, 109, 110, 116, 117, 121, 122, 126, 128, 129, 131, 133, 135, 136, 142, 150, 152, 154, 155, 161, 162, 163, 171, each	$6 00
4094.	For Architects, containing 30 colors, Nos. 100, 104, 105, 106, 109, 110, 116, 117, 121, 122, 126, 128, 129, 131, 132, 133, 135, 136, 137, 138, 142, 150, 152, 154, 155, 161, 162, 163, 170, 171	7 25
4095.	For Machinists, containing 15 colors, Nos. 102, 103, 108, 111, 112, 117, 127, 130, 131, 134, 140, 142, 152, 161, 171	4 50
4096.	For Surveyors, containing 15 colors, Nos. 105, 114, 115, 116, 117, 118, 119, 120, 125, 131, 135, 151, 152, 153, 171	4 50

GERMAN COLORS IN CAKES.

4097. PER CAKE, 20 CTS.

100.	Azure Blue,	Lufblau.
101.	Black Lead,	Graphit.
102.	Brick,	Backstein.
103.	Bronze,	Bronce.
104.	Burnt Roman Ochre,	Gebr. rom. Ocker.
105.	Burnt Sienna,	Gebr. Sienna.
106.	Burnt Umber,	Gebr. Umber.
107.	Brown Ochre,	Brauner Ocker.
108.	Cast-iron,	Gusseisen.
109.	Chinese White,	Deckweiss.
110.	Chrome Yellow,	Chromgelb, hell.
111.	Composition Metal,	Compositions metall.
112.	Copper,	Kupfer.
113.	Deep Chrome,	Chromgelb, dunkel.
114.	Field Brown,	Feldbraun.
115.	Forest Green,	Waldgrun.
116.	French Green,	Franzosichgrun.
117.	Gamboge,	Gummigutt.
118.	Garden Green,	Hausgartengrun.
119.	Grape Violet,	Rebenviolett.
120.	Heath Green,	Haidegrun.
121.	Indian Red,	Indischroth.
122.	Indigo,	Indigo.
123.	Lamp Black,	Lampenschwarz.
124.	Light Red,	Lichtroth.
125.	Meadow Green,	Wiesengrun.
126.	Naples Yellow,	Neapelgelb.
126½.	Neutral Tint,	Neutral-Tinte.
127.	Oak,	Eichenholz.
128.	Orange,	Orange.
129.	Payne's Grey,	Payne's Grau.
130.	Pine,	Tannenholz.
131.	Prussian Blue,	Preussischblau.

132.	Prussian Green,	Preussischgrun,
133.	Raw Sienna,	Sienna.
134.	Sand Stone,	Sandstein.
135.	Sap Green,	Saftgrun.
136.	Red Lead,	Saturnroth.
137.	Vandyke Brown,	Vandyke Braun.
138.	Venetian Red,	Venetianischroth.
139.	Violet Lake,	Violetter Lack.
140.	Wood,	Holz.
141.	Yellow Lake,	Gelber Lack.
142.	Yellow Ochre,	Gelber Ocker.
4098.	PER CAKE,	30 CTS.
150.	Crimson Lake,	Carminlack, hell.
151.	Farm Buildings,	Oeconomiegebaude.
152.	Sepia,	Sepia, naturlich.
153.	Stone Buildings,	Steinerne Gebaude.
154.	Ultramarine,	Ultramarin.
155.	Vermilion,	Zinnober.
4098½.	PER CAKE,	60 CTS.
160.	Brilliant Yellow,	Brillantgelb.
161.	Cobalt,	Cobaltblau.
162.	Indian Yellow,	Indischgelb.
163.	Rose Madder,	Krapplack, rosa.
164.	Scarlet Lake,	Scharlachlack.
4099.	PER CAKE,	90 CTS.
170.	Brilliant Blue,	Brillantblau.
171.	Carmine, extra fine.	Carmin, extra fein.
172.	Ultramarine, extra fine.	Ultramarin, extra fein.

WINSOR & NEWTON'S WATER COLORS.

FULL CAKE OR PAN, 25 CTS. HALF CAKE OR PAN, 15 CTS.

4100.

1. Antwerp Blue.
2. Bistre.
3. Blue Black.
*4. British Ink.
5. Brown Ochre.
6. Brown Pink.
*7. Bronze
8. Burnt Sienna.
9. Burnt Umber.
10. Chinese White.
11. Chrome Yellow.
12. Cologne Earth.
14. Deep Chrome.
18. Gamboge.
19. Hooker's Green, No. 1.
20. Hooker's Green, No. 2.
21. Indigo.
22. Indian Red.
23. Italian Pink.
24. Ivory Black.
*25. King's Yellow.
26. Lamp Black.
27. Light Red.
28. Naples Yellow.
32. Orange Chrome.
33. Payne's Gray.
34. Prussian Blue.
35. Prussian Green.
36. Raw Sienna.
37. Raw Umber.
*38. Red Lead.
*39. Red Ochre.
40. Roman Ochre.
41. Sap Green.
42. Terre Verte.
43. Vandyke Brown.
44. Venetian Red.

*15. Dragon's Blood.	29. Neutral Tint.	45. Vermilion.
16. Emerald Green.	30. New Blue.	47. Yellow Lake.
*17. Flake White.	31. Olive Green.	48. Yellow Ochre.

FULL CAKE OR PAN, 45 CTS. HALF CAKE OR PAN, 25 CTS.

4101.

*49. Black Lead.	53. Indian Yellow.	58. Ruben's Madder.
50. Brown Madder.	54. Mars Yellow.	59. Scarlet Lake.
*51. Chalon's Brown.	55. Neutral Orange.	60. Scarlet Vermilion.
*13. Constant White.	56. Purple Lake.	61. Sepia.
52. Crimson Lake.	57. Roman Sepia.	62. Warm Sepia.

FULL CAKE OR PAN, 65 CTS. HALF CAKE OR PAN, 35 CTS.

4102.

63. Cobalt Blue.	64. Orange Vermilion.	65. Violet Carmine.

FULL CAKE OR PAN, 90 CTS. HALF CAKE OR PAN, 45 CTS.

4103.

66. Aureolin.	72. Gallstone.	77. Pale Cadmium Yellow.
67. Burnt Carmine.	73. Green Oxide of Chromium.	78. Pink Madder.
68. Cadmium Yellow.	74. Indian Purple.	79. Pure Scarlet.
69. Cadmium Orange.	75. Intense Blue.	80. Rose Madder.
70. Carmine.	76. Lemon Yellow.	81. Viridian.
71. French Blue.		

FULL CAKE OR PAN, $1.40. HALF CAKE OR PAN, 70 CTS.

4104.

82. Purple Madder.	*85. Field's Orange Vermilion.	*86. Madder Carmine.
83. Smalt.		87. Mars Orange.
84. Ultramarine Ash.		

4105.

88. Genuine Ultramarine, ¼-cake, each.......... .... $2 25

Colors marked * are not made in full and half pans.

WINSOR & NEWTON'S FULL CAKE WATER COLOR BOXES.

FITTED.

No.		Price.
4106.	12 Cakes, Polished Mahogany Slide Lid Box, each.................	$5 00
4107.	18 " " " "	7 50
4108.	12 " " Lock Box "	6 00
4109.	18 " " " "	9 00
4110.	12 " " Lock and Drawer Box, each........	6 50
4111.	18 " " " "	10 00
4112.	12 " " Complete Box fitted, "	10 00
4113.	18 " " " "	14 00
4114.	24 " " " "	18 00

HALF CAKE WATER COLOR BOXES.

FITTED

No.		Price.
4116.	12 Half Cakes, Polished Mahogany Slide Lid Box, each	$3 00
4117.	18 " " " "	4 25
4118.	12 " " Lock Box, "	4 50
4119.	18 " " " "	6 00
4120.	12 " " Lock and Drawer Box, each	5 50
4121.	18 " " " "	7 00
4122.	12 " " Complete Box fitted, "	6 00
4123.	18 " " " "	8 00
4124.	12 " " Caddy Lid Box complete fitted, each	9 00
4124-1.	18. Half Cakes, Polished Mahogany, Caddy Lid Box complete fitted, each	11 00

FRENCH WATER COLOR BOXES,

IN GREAT VARIETY, FROM 50 CENTS TO $10 EACH.

EMPTY JAPANNED TIN BOXES.

FOR MOIST COLORS IN PANS.

	Winsor & Newton's.	American.
4125, for 6 full or 12 half pans, each	$1 50	each $1 00
4126, for 8 full or 16 half pans, each	1 75	" 1 15
4127, for 10 full or 20 half pans, each	2 00	" 1 25
4128, for 12 full or 24 half pans, each	2 25	" 1 45
4129, for 16 full or 32 half pans, each	2 50	" 1 60
4130, for 20 full or 40 half pans, each	2 75	" 1 75
4131, for 24 full or 48 half pans, each	3 00	" 2 00

JAPANNED TIN BOXES.

WITH COLORS FOR SKETCHING.

4131½. Japanned tin box with colors, containing:

6	8	10	12	16	20	24 colors.
$1 35	$1 50	$1 80	$2 20	$3 00	$3 75	$4 50

WATER COLOR LIQUIDS.

No.		Price.
4132.	Winsor & Newton's Chinese White, each	40
4133.	" Indian Ink, "	40
4134.	" Oxgall "	40
4135.	" Gold Ink, "	65
4136.	" Carmine, "	50
4137.	" Indelible Brown Ink, each	50
3138.	" Prout's Brown, each	50
4138½.	" Sepia, each	50

LIQUID INDELIBLE DRAWING INK.

4160.	Liquid Indelible Drawing Ink, Black, each	50
4161.	" Brown, "	50
4162.	" Blue, "	50
4163.	" Green, "	50
4164.	" Scarlet, "	50
4165.	" Carmine, each	50

These Indelible Drawing Inks are a valuable addition to the draughtsman's outfit, and specially adapted for Mechanical Drawing. The lines drawn with these colors are perfectly indelible and will not be blurred or defaced by frequently applied brush tints. Used with the brush large washes can be laid on more even and with less trouble than with cake or moist water colors.

4139.	Keuffel and Esser's Liquid Color, Carmine, each	40
4140.	" " Sepia, "	40
4141.	" " Oxgall "	30
4142.	" " Blue, "	30
4143.	" " Green, "	30
4154.	Dr. Schoenfeldt's Chinese White in bottles, "	35
4155.	" " in tubes, "	20

This Chinese White is highly recommended and used by many of our leading artists in preference to all others. Wood engravers will find it to suit their purpose best.

4145.	Pure Gold in Cakes, each	2 00
4146.	Pure Gold in Shells, each	20
4147.	Pure Gold in Cups, 1 inch, each	15
4148.	Pure Gold in Cups, 1½ inch, each	25
4150.	Pure Silver in Shells, each	10
4151.	Metallic Cake Colors, in China Saucers, Gold	35
4152.	Metallic Cake Colors, in China Saucers, Silver	30
4156.	California Gold-Paint for decorating purposes, per box, containing 2 bottles, each	35

EMPTY MAHOGANY COLOR BOXES WITH SLIDE LID.

4170.	For W. & N. Half Cakes,	12	18	24	colors.
	each,	50	60	75	
4171.	For W. & N. Full Cakes,	12	18	24	colors.
	each,	60	75	1 00	

Chinese or Indian Inks, solid and liquid; also Sable and Camel Hair Brushes in large varieties.

CHINA AND GLASSWARE.

No.		Price.
4348.	Poole's Patent Ink Slab, each	$ 75
4350.	Keuffel and Esser's Patent Ink Slab, with cover, 1¾x1⅓ inch, each	50
4351.	" " " " " 2⅓x5¾ " "	60
4352.	Nest of Cabinet Saucers, 6 in set, 2⅜ inch, set	60
4353.	" " 6 " 2⅝ " "	70
4354.	" " 6 " 3¼ " "	80
4355.	" " 6 " 3¾ " "	1 00
4353–1.	" " deep 4 " 2⅝ " "	1 20
4354–1.	" " " 4 " 3¼ " "	1 50
4355–1.	" " " 4 " 3¾ " "	1 75
4359.	Architect's Slant and Basin, with 8 divisions and cup, each	1 35
4360.	Ink or Color Slab, 3 holes and slope, 1½x2¾ inch, each	15
4361.	" " 2⅜x3⅜ "	25
4362.	" " 2¾x4¼ "	30
4363.	" " 3x4½ "	35
4363½.	" " 3¼x5 "	45
4364.	Well Slab, with 3 Wells and Slope, each	25
4365.	" " 5 " "	70
4366.	Sloping Tile, 3 divisions, 2½x4 inch, each	20
4367.	" 4 " 3⅛x7¾ "	35
4368.	" 5 " 3⅛x7¾ "	45
4369.	" 6 " 3⅛x7¾ "	55
4370.	" 8 " 6x7⅝ "	70
4371.	" 10 " 6x7⅜ "	1 00
4371½.	" 12 " 6x7⅝ "	1 20

4372.	China Color Cups	1½	2	2½	3	3½ inch diam.
	Each	$ 6	10	15	25	30.

4373.	Centre Slab, 5 divisions, 2⅜x6 inch, each	25

LEAD PENCILS.

GRAPHITE, PLUMBAGO, BLACK LEAD.

Eighty-one Highest Prizes for Unrivalled Products. Silver Medal, Paris, 1867; Medal for Progress, Vienna, 1873; Medal for Merit, Vienna, 1873; Highest Award, Centennial, 1876; Five Medals, American Institute, 1878; Two

Gold Medals, Paris, 1878. Dixon's fine American Graphite Pencils, five regular grades of hardness of leads, in both round and hexagon shape and beautifully finished in different styles, black, maroon and natural color, and new "satin finish" style, so popular that it is now being imitated by the other makers.

S.—Soft. For heavy shading in sketch drawing, or for any use in which a large black mark is desired.

S. M.—Soft Medium. The most popular goods we make. This grade is used for the pocket, or for general drawing and sketching, and is wonderfully smooth. For all ordinary office use it has no equal.

M.—Medium. For professional and desk work, and all finer uses where a harder lead than the S. M. is wanted; for accountants, stenographers, draughtsmen, physicians, etc.; for memorandum books, it is just right; for drawing on paper not very smooth, it is exactly right.

H.—Hard. A hard but smooth lead, suitable for ledger work or outline drawing; for civil engineers, architects, draughtsmen, etc.; very fine lines; drawings made with this grade need not be inked for the machine shop or for building plans; suitable for compass use.

V. H.—Very Hard. For the finest lines, almost equal to engraving, but still black and smooth.

Ten Grades of Leads in Artists' Pencils, in hexagon shape, and exquisitely finished in the natural color of the cedar wood only.

Grade Stamps are as follows, viz.:

Trade No.		Similar Grade to the European Stamp of
210.	V.V.S.—Very, very soft	B.B.B.
211.	V.S.—Very soft	B.B.
212.	S.—Soft	B. and No. 1.
213.	S.M.—Soft Medium	H.B. and No. 2.
214.	M.B.—Medium Black	F.
215.	M.—Medium	H. and No. 3.
216.	M.H.—Medium Hard	H.H.
217.	H.—Hard	H.H.H. and No. 4.
218.	V.H.—Very hard	H.H.H.H. and No. 5.
219.	V.V.H.—Very, very hard	H.H.H.H.H.H.

	Price per doz.
Round Shape, black finish, standard style	$ 50
Hexagon " maroon " " "	60
Dixon's A. G., plain " Round	30
" " " " Hexagon	40
Lumber Pencils, all lead, paper cover or Japanned	75
Dixon's Professional Pencils, round, 5 grades	30
" " " hexagon, "	40
Artists' Pencils	1 00
Compass, School and Gem Pocket Pencils	50

Etc., Etc., Etc.

Send a postage stamp for circular.

Methodical Text-Book to Round Writing by F. Soennecken, published by Keuffel & Esser, New York, including an assortment of 25 single and double pointed pens, each....................$1 40, post-paid $1 50

Methodical Text-Book, without pens .... 1 10, post-paid, $1 15
Methodical Text-Book, bound in cloth, with 25 pens .... 2 00, " 2 18
Copy-Book without instructions (School Edition), including an assortment of 25 pens, each .... 90, post-paid 1 00
Copy-Book without pens .... 60, " 64

Pens, single pointed.

Nos.	1	2	2½	3	3½	4	5	6
	BBB	BB	B	M	MF	F	FF	FFF

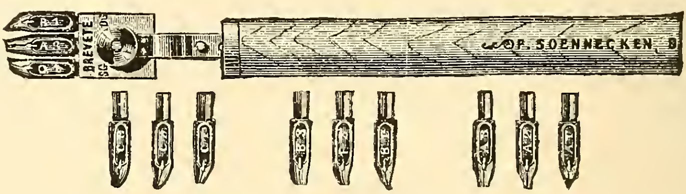
per gross $1 10, post-paid $1 25
" ½ " 35, " 41

Pens, double pointed, Nos.	10	20	30
	B	M	F

per ½ gross $1 00, post-paid $1 06
per dozen 50, " 53

Every gross or ½ gross box contains pens of one number only.

Sample assortment Single and Double pointed pens, 25 in a box, 35, " 41
Ink-holder to be applied to Single and Double Pens, specially for writing with India Ink and Autograph Ink, per box of 6........30 cts., each 10



Round Writing Instruments, complete with 9 pens, each $1 50, postage paid $1 60
Minute pens only .... doz. 75, each 10

With this Instrument, 2 or 3 parallel lines can be made with one movement; it is used exactly in the same manner as the common single and double round writing pens.

The accompanying 9 minute pens allow to produce 144 different double and 504 different triple lines, by simply changing the pens in the different places in the holder.

Parcel-Pens, in 4 different widths, for bold and large lettering.

Nos.	131	133	135	137	
	F	M	B	BB	
	$\frac{7}{100}$	$\frac{7}{50}$	$\frac{13}{50}$	$\frac{19}{50}$	inch wide, each, 25

FLUENT WRITING PENS.

Nos.	203	204	205	206	207	208	square pointed
	103	104	105	106	107	108	oblique pointed
	BBB	BB	B	M	F	FF	

	per gross $1 10,	postage paid	$1 25
	" ¼ " 35,	"	41
Sample box, containing 25 pens, assorted	25,	"	31
Pen-holders for round writing and fluent writing pens, each			10

CEDAR BOXES WITH ROUND WRITING PENS.

Containing 11 pen-holders and pens, assorted, each 2 00

RULED PAPER IN SHEETS.

Six patterns for round writing, each 6

These sheets are placed under plain paper to serve as lines to write on.

RUBBER.

A. W. Faber's Artist's Rubber, in Cakes, each .... 10 to 50
" Natural or Virgin Rubber, in Cakes, each .... 20 to 50
" Black Rubber, in Cakes, each .... 10 to 50
" Ink Eraser, in Cakes, each 6
" Ink Eraser, in Cakes, large, each .... 10 to 20
Ink and Pencil Eraser in Cakes, each 15
Ink and Pencil Eraser in Cakes, Mammoth, each 25
Green's Ink Eraser, each 6
Velvet Rubber, oblong, each .... 10 to 50

SPONGE RUBBER.

FOR CLEANING DRAWINGS.

0. Small Cakes, about 1x1x1 inch 10
2. Medium Size, Rubber Back (Glove Cleaner), 2¼x1⅝x⅝ inch 25
3. Large Size, 4x2x1 inch 60
4. Mammoth Size, 6x4x1 inch 1 80
1. Pencil Pointer, 2x2½ inch, each 10
2. " 2½x4 " 15
3. " 1½x4 " 12
Arkansas Oil Stones, each from .... 25 to 1 50
Arkansas Oil Deskstones on wood, each 75

Arkansas Oil Stones, in case with cover,	3	4	5	6	7	8 inch
each	$1 00	1 50	2 00	2 25	2 50	2 80

Mouthglue, per dozen 40
Mouthglue, fine perfumed, per dozen 80
Mucilage, in glass bottles with brush, each 25

A. W. FABER'S PENCILS.

No.			Price.
4400.	Hexagon, very best Siberian, No. 2 B. to 6 H., ...	per doz.	$1 25
4401.	" " Drawing, Nos. 1–5	"	75
4402.	Black round, best, " 1–4	"	60
4403.	Yellow polished, round, " 4 B. to 4 H	"	60
4404.	Hexagon, for Mathematical Instruments, No. 4	"	70
4405.	Round, " " "	"	60
4406.	Ivory Pocket Pencil, with movable lead, 2⅝ inch, each		50
4407.	" " 3⅛ "		60
4408.	" " 3½ "		75
4409.	Artist Pencil with Siberian Lead, double pointed, each		35
4410.	" " "		25
4411.	" best " "		20
4412.	Leads for Artist Pencils, Siberian, 6 in box, per box		65
4413.	" " best, " "		35
4414.	Hexagon carmine and blue pencils, per doz		1 25
5415.	Round " " "		1 00
4416.	" blue, per doz		75
4416½.	A. W. Faber's Wax Crayons, per doz., $1.25; each		12

No. 1, White; 2, Yellow; 13, Dark Blue; 30, Sienna; 38, Vermilion; 54, Purple; 62, Orange; 63, Light Green; 69, Dark Green; 75, Carmine; 88, Light Blue; Black.

A. W. Faber's Wax Crayons in boxes, assorted colors:

Nos	6	12	18	24	36	48
Each	$ 80	$1 50	$2 00	$2 50	$3 50	$4 50

4417.	A. W. Faber's Pencil Cases, with 5 Siberian Lead Pencils, each	$1 00
4418.	" 7 " " "	1 25
4419.	" 10 " " "	1 75
4420.	" 5 " " Rubber and Knife each	1 25
4421.	" 5 Yellow round " each	60
4422.	" 7 " " "	75
4423.	" 10 " " "	85
4424.	" 5 " " Rubber and Knife, each	1 00
4425.	Red Chalk, in cedar, for marking stakes, doz	75
4426.	" in sticks, covered with paper, "	25
4427.	" " " " "	50
4428.	Black Conte Crayons in Wood, No. 1–2, "	60
4429.	" " " " 3 "	90
4430.	" " " Velours, very soft, doz	1 25
4431.	White " " doz	60

No.			Price.
4432.	Black Conte Crayons, square, No. 1, 2, 3, doz. in a box, per doz....		20
4433.	" " round, " 1, 2, 3, " "		40
4434.	" " " polished " "		60
4435.	White " square, No. 1, 2, 3, " "		20
4436	" " round, " 1, 2 " "		40
		Small.	Large.
4437.	Conte Crayon Sauce, in tin foil.................per doz.,	$ 75	$1 20
4437-2.	" " common, not in tin foil.... "	30	50
4438.	Paper Stumps, assorted, doz....................................		35
4439.	Chamois Leather Stumps, assorted, doz		1 25
4439-1.	White Kid " " "		1 50
4439-2.	Cork " " "		1 50
4439-3.	Minute " for very delicate work, gray paper, doz..		10
	" " " rose or white, " ..		12
4439-4.	Rubber Stumps, wood centre, No. 1, 4½ inch, each.............		15
	" " " 2, 5¼ " "		25
	" " " 3, 5¾ " "		35
4439-5.	Rubber Stamps, all Rubber, " 10, 4 " "		12
	" " " 20, 3½ " "		10
	" " " 30, 2½ " "		8
4440.	Crayon Holder, Brass, 5 inch and 6 inch....................each,		8
4440-2.	" " 5½ " .... "		6
4440-3.	" " 7 " extra large and heavy......... "		20
4441.	" German Silver, 5 inch...................... "		25
4442.	" Brass, Ebony Handle, 5 inch............... "		10
4443.	" " " " fine............. "		15
4444.	" German Silver, Ebony Handle, 5 inch, fine... "		25
4445.	" Brass, double wooden centre, 7 inch......... "		25
4446.	" German Silver, double wooden centre, 7 inch, "		40
4446-1.	Crayon, Pencil and Charcoal Holder combined............ "		35
4446-2.	Crayons, round, for above, 6 in tin box, No. 1 or 2, each box....		25

CHARCOAL.

4447.	Charcoal, 50 sticks in a box...............................each,	$ 25
4447-2.	" " extra large... .... "	40
4448.	" " fine........................ .... "	40
4449.	" " extra fine........... .. .. "	60
4449-1.	" Rouget's Patent, assorted according to the different degrees of hardness, Nos. 1, 2, 3, 25 sticks in a box..... "	40
4449-2.	Crayon Pointer, a very useful instrument to point Charcoal and Crayons, each..	20
4449-3.	Burnt Rubber, small, each..	6
4449-4.	" large, "	10
	(A prepared Rubber indispensable for Drawing in Crayon.)	
4449-5.	Rouget's Fixative, a preparation to make Crayon Drawings indelible, bottle..	50

No.		Price.
4449-7.	Crayon Box, polished, with lock and key, fitted with Crayons, Crayon-holders, Charcoal, Rubber, Stumps, Pencils, etc., etc., each	$1 65
4449-8.	do. do. do., finer and more complete, each	2 65

(Larger Crayon Boxes fitted up to order.)

STEEL PENS.

4450.	Lithographic Crow Quill,	Joseph Gillot's, doz		$ 75
4450½.	Superfine long shoulder Crow Quill,	"	"	1 00
4451.	Lithographic Pen,	"	"	75
4452.	Mapping "	"	"	75
4453.	" or Ladies' Pen, No. 170,	"	"	15
4454.	Lettering Pen, " 303,	"	"	20
	" " 404,	"	"	15
4455.	Crow Quill Pen, with holder, French,		"	50
4456.	" " " " English,		"	50
4457.	Gold Lettering Pens, wooden holder,		"	2 00
4458.	Keuffel & Esser's Drawing and Lettering Pens,		"	60

The pens 4458 are specially made for draughtsmen, to be used for drawing and lettering on drawing paper which has a more or less coarse surface.

These pens, having longer nibs and less sharp points than most of those heretofore in use, possess a great elasticity and allow to draw or letter more rapidly, without annoying the draughtsmen by continuously scratching or catching the nibs of the pens in the grain of the paper. Draughtsmen will prefer those pens to Crow Quill, Mapping or Lithographic Pens, all of which are intended principally for drawing on stone.

Send for separate lists of A. W. Faber's Demestic Pencils, A. W. Faber's Gold Pens and Pencil Cases, A. W. Faber's Rubber Goods, E. Faber's Penholders, E. Faber's Miscellaneous Stationers' Articles, any of which we will mail on receipt of postage.

NO. 1, CHEMICAL CABINET.

Contains 60 Chemical Tests and Apparatus. Without strong acids or other dangerous articles. They are perfectly safe in the hand of youth, and are admirably adapted as presents. Prices :

No. 1, Cedar Case, with Book of Experiments	$ 3 50
No. 2, polished Black Walnut Case with lock, with Book of Experiments,	4 50

CONTENTS.

Acetate of Lead, Alum, Benzoic Acid, Bichromate of Potash, Biborate of Soda, Carbonate of Magnesia, Camphor, Caustic Potash, Carbonate of Potash, Charcoal, Chloride of Cobalt, Chlorate of Potash, Fluate of Lime, Gum Arabic, Isinglass, Litharge, Logwood, Lycopodium, Muriate of Ammonia, Nitrate of Baryta, Nitrate

of Copper, Nitrate of Mercury, Nitrate of Potash, Nitrate of Silver, Nitrate of Strontian, Oxalate of Ammonia, Oxide of Manganese, Phosphorized Oil, Phosphuret of Lime, Prussiate of Potash, Red Lead, Resin, Steel Filings, Stourbridge Clay, Sulphate of Copper, Sulphate of Iron, Sulphate of Soda, Sulphur, Sulphuret of Antimony, Tartaric Acid, Tincture of Galls, Tincture of Litmus.

APPARATUS.

Glass Mortar and Pestle, Glass Spirit Lamp, Cotton Wick, Metallic Capsule, Triangular Crucible, Conical Test Glass, Tripod Stand, Glass Stirring Rod, Glass Tube, Test Tube, Glass Funnel, Filtering Paper, Litmus Paper, Tumeric Paper, Tin Foil, Metallic Zinc, Sheet Zinc, French Chalk.

NO. 2, LABORATORY CABINET.

PRICE, WITH BOOK, $6 00.

Contains 54 Chemical preparations, and 30 pieces of Apparatus. Free from danger.. 6 00

CONTENTS.

Acetate of Lead, Alum, Antimony, Benzoic Acid, Biborate of Soda, Bichromate of Potash, Boracic Acid, Carbonate of Ammonia, Carbonate of Lime, Carbonate of Magnesia, Carbonate of Potash, Carbonate of Soda, Camphor, Caustic Potash, Chloride of Ammonium, Chloride of Lime, Chloride of Cobalt, Chlorate of Potash, Charcoal, Fluate of Lime, Galena, Granulated Zinc, Gum Arabic, Isinglass, Iron Filings, Litharge, Litmus, Logwood, Lycopodium, Nitrate of Barytes, Nitrate of Copper, Nitrate of Mercury, Nitrate of Silver, Nitrate of Strontian, Oxalate of Ammonia, Oxide of Lead, Oxide of Manganese, Phosphate of Soda, Phosphorized Oil, Phosphuret of Lime, Prussiate of Potash, Staurbridge Clay, Sulphuret of Antimony, Sulphate of Copper, Sulphate of Iron, Sulphate of Magnesia, Sulphate of Soda, Sulphur, Sulphuret of Iron, Tartaric Acid, Tincture of Litmus, Tincture of Galls, Test Papers.

APPARATUS, ETC.

Glass Spirit Lamp, Glass Mortar and Pestle, Triangular Crucible, Conical Test Glass, Ribbed Glass Funnel, Packet of Filters, Tripod Stand, Two Test Tubes, Test Tube-holder, Test Tube-cleaner, Tin Capsule, Porcelain Evaporating Basin, Bohemian Flask, Pipette, 3 Glass Tubes, 2 Glass Stirrers, Litmus Paper, Tumeric Paper, Slip of Copper, Slip of Zinc, Tin Foil, Two Glass Slips for Testing, Iron Rod for Testing, Copper Rod for Testing, Bibulous Paper.

NO. 3, STUDENT'S CHEMICAL CABINET.

Contains 36 boxes and 12 bottles filled with Chemicals, and a large assortment of Apparatus of practically useful size. Arranged in polished black walnut cabinet, with lock........................ 8 00

CHEMICALS.

Alum, Ammonia Carbonate, Ammonia Caustic, Chloride, Oxalate, Antimony Sulphide, Barium Chloride, Baryta Nitrate, Benzoic Acid, Boracic Acid, Charcoal, Cobalt Chloride, Copper Nitrate, Copper Sulphate, Galls Tincture, Iron Filings, Potash Bichromate, Iron Sulphate, Iron Sulphide, Lead Acetate, Lime Carbonate, Lime Chloride, Lime Fluate, Lime Phosphuret, Litharge, Litmus, Litmus Tincture, Lycopodium, Magnesia Carbonate, Manganese Oxide, Phosphorus, Potash Carbonate, Potash Caustic, Potash Chlorate, Potash Prussiate, Potash Nitrate, Potash Sulphate, Silver Nitrate, Soda Biborate, Soda Carbonate, Soda Phosphate, Soda Sulphate, Strontian Nitrate, Sulphur, Tartaric Acid, Tumeric, Zinc Granulated.

APPARATUS.

Glass Mortar and Pestle, Glass Spirit Lamp, Wick for Spirit Lamp, Evaporating Basin, 3 Test Tubes, assorted, Test Tube Cleaner, Test Tube Holder, Bohemian Flask, Bulb Boiling Tube, 2 Glass Tubes, Sheet Litmus Paper, Sheet Tumeric Paper, Sheet Bibulous Paper, Ribbed Glass Funnel, Packet of Filters for Funnel, 2 Glass Stirring Rods, Oxygen Tube Retort, Watch Glass, Tinned Sand Bath, Tinned Capsule, Cylindrical Test Glass, 3 Hessian Crucibles, Copper Rod, Iron Rod, Zinc Rod, Pipette, Retort Stand.

NO. 4, STUDENT'S PORTABLE CHEMICAL CABINET.

In handsome polished black walnut cabinet, containing 42 pieces of apparatus and 50 chemical preparations, in all 92 articles suitable for any text book in chemistry. Price, $14 00

CONTENTS.

Retort Stand, 1 Ring; Porcelain Mortar and Pestle, No. 00; Glass Spirit Lamp, 1 oz.; Cotton Wick, 3 feet; Blowpipe, Platinum Blowpipe Wire, Platinum Foil, Iron Spoon for Fusions, Albata Test Spoon, Set of 3 Beaker Glasses, Glass flask, 3 oz.; Test Tubes, 3 x ½ and 4 x ½ inch; Test Tubes, 4 x 1 and 5 x ½ inch; Test Tubes, 3 x ⅜ inch (3); Berzelius Bulb Tube (2); Watch Glass, 2 inch; Porcelain Capsule and handle (2), Funnel, No. 2, 1½ inch; Filters for Funnel, 2¾ inch (100); Funnel, No. 1, 1½ inch; Filters, for No. 1, 2½ inch (100); Clark's Test Glass, Book of Litmus Paper, Book of Tumeric Paper, Test Metals, Fe, Cu, Zn; Stirrers, 1 each, 3 inch and 6 inch; Filtering Ring, 2 arms; Straight Pipette, 6 inch; Open Glass Tubes, ⅛ to ¼ inch (4); Tube Holder with Handle; Porcelain Crucible, No. 0; Porcelain Basin, No. 0; Porcelain Cup, No. 1; Porcelain Cup, No. 3; Porcelain Cup, No. 6.

FIFTY CHEMICAL PREPARATIONS.

Contained in 4 stoppered ½ oz. bottles, 10 corked ½ oz. bottles, 14 ½ oz. wooden boxes, and 22 ½ oz. paper boxes, as follows:

Alum, Ammonia Carbonate, Ammonia Chloride, Ammonia Oxalate, Antimony Sulphide, Barium Chloride, Boracic Acid, Bleaching Powder, Calcium Chloride,

Cobalt Chloride, Cobalt Nitrate, Copper Nitrate, Copper Sulphate, Fluor Spar, Galena, Galls Tincture, Iron Pyrites, Iron Sulphate, Iron Sulphide, Lead Acetate, Lead Carbonate, Litharge, Litmus, Magnesium Carbonate, Magnesium Sulphate, Manganese Peroxide, Microcosmic Salt, Oxalic Acid, Phosphorus, Potassium Bichomatic, Potassium Binoxalate, Potassium Cyanide, Potassium Carbonate, Potassium Chlorate, Potassium Ferridcyanide, Potassium Ferrocyanide, Potassium Hydrate, Potassium Iodide, Potassium Sulphate, Silver Nitrate, Sodium Borate, Sodium Carbonate, Sodium Phosphate, Strontium Nitrate, Sulphur, Tartaric Acid, Tin Granulated, Tin Protochloride, Zinc Granulated.

NO. 5, STUDENT'S PORTABLE CHEMICAL CABINET.

In handsome polished mahogany cabinet, containing over 72 pieces of chemical apparatus of a good working size, for manipulating in the gases, etc., and 60 chemical preparations. This set is suitable for performing the the experiments in any text book. Price, $22 00.

Retort Stand, 3 Rings; Porcelain Mortar, No. 00; Glass Spirit Lamp, 1 oz.; Cotton Wick, 1 yard; Blowpipe, Platinum Blowpipe Wire, Platinum Blowpipe Foil, Albata Test Spoon, Iron Spoon for Fusions, Iron Tongs with Spoon, Set of 3 Beaker Glasses, Glass flasks, 1, 2 and 3 oz.; Bulb Tube, large size (2); Gas bottle, funnel and tube, small; Cork and Jet for ditto; Test Tubes, 3 x ⅝ inch (2); Test Tubes, 4 x ⅝ inch (3); Test Tubes, 6 x 1 inch (1); Test Tubes, 3 x ½ inch (6); Folding Frame for 6 tubes, Glass Funnel No. 1, 1½ inch; Glass Funnel No. 2, 1½ inch; Filters for No. 1 Funnel (100); Filters for No. 2 Funnel (100); Filter Ring, 2 arms; Clark's Test Glass; Box of six Test Paper Books, Porcelain Test Plates, Nos. 8 and 9 (2); Stirrers, 2 each, 3 and 6 inch; Open Tubes, ⅛ and ¼ inch (2); Test metals; Cu, Fe, Zn; Test Tube Holder, Straight Pipette, 6 in.; Test Tube Brush; Glass Retort, 2 oz.; Glass Receiver, 2 oz.; Watch Glasses, 2 in. (2); Porcelain Basin, No. 00; Porcelain Basin, No. 1, Porcelain Cup, No. 12 (2); Porcelain Cup, No. 10; Porcelain Cup, No. 1; Porcelain Cup, No. 2; Porcelain Crucible, No. 000; Porcelain Crucible, No. 00; Beehive Shelf, 4 inch; Graduated measure, 4 oz.; Alum, Ammonia Caustic, Ammonia Carbonate, Ammonia Chloride, Ammonia Oxalate, Antimony Sulphide, Arsenious Acid, Barium Chloride, Barium Chloride Solution, Barium Nitrate, Boracic Acid, Benzoic Acid, Calcium Chloride Solution; Cobalt Nitrate Solution, Cobalt Ore, Copper Sulphate, Copper turnings, Fluor Spar, Galena, Iron Pyrites, Iron Sulphate, Iron Snlphide, Lead Acetate, Lead Acetate Solution, Lead Carbonate, Lead Nitrate Solution, Litharge, Litmus, Magnesium Carbonate, Magnesium Sulphate, Manganese Peroxide, Mercurous Chloride, Microcosmic Salt, Oxalic Acid, Phosphorus, Platinum Bichloride Solution, Potassium Bichromate, Potassium Binoxalate, Potassium Bitartrate, Potassium Chlorate, Potassium Cyanide, Potassium Ferricyanide, Potassium Ferrocyanide, Potassium Ferricyanide Solution, Potassium Hydrate, Potassium Iodide, Potassium Nitrate, Potassium Sulphate, Realgar, Silver Nitrate Solution, Sodium Borate, Sodium Carbonate, Sodium Phosphate, Strontium Chloride, Strontium Nitrate, Sulphur, Tartaric Acid, Tin Chloride, Tin Granulated, Zinc Granulated.

A SET OF APPARATUS AND CHEMICALS,

Intended to illustrate a first course of chemical experiments, as explained in Chemical Recreations by J. J. Griffin. The apparatus in this set are intended to illustrate elementary chemistry, the qualitive analysis of salts, and centigrade testing. This is the set for teachers in schools; price, $30 00.

GRIFFIN'S CHEMICAL RECREATIONS.—PART I. PRICE $1 00.

SET A—FOR INDICATING TESTS.

Porcelain Mortar, No. 00; Albata Test Spoons, Flask, 2 oz.; Pipette, 25 Septems; Glass Spirit Lamp, Cotton Wick for Lamp, Brass Tongs to trim Lamp, Furnace Cylinder, Trellis Top for Furnace, Box with 100 Filters, 2½ inch; Filter Ring, Water Bottle, Glass Funnel, 1½ inch; Support for Funnel, Pipettes, 5 inch (2); Test Glasses, Conical (8); Stirrers, 3 inch (8); Boiling Tubes, 6 x 1 inch (2); Handle for Hot Tubes, Book of Red Litmus, Book of Blue Litmus, Tubes for S. H. Gas, Pipette Bottles, 1 oz. size (9); Bottles with Stoppers, 1 oz. (2).

SET B—FOR CONFIRMING TESTS.

Porcelain Cup, 1 inch; Retort Stand, Blowpipe, Blowpipe Lamp and Stand, Platinum Wires (2), Platinum Foils (2), Platinum Tongs, Thin Copper Wire, Charcoal Pastiles (36), Crucibles for Pastiles (2), Wire Supports for Pastiles (2), Hammer, Anvil, Closed Tubes, 2 x ½ inch (3); Box Test Papers, Support for Sublimates, Borax in a Box, Microcosmic Salt in a Box, Soda Carbonate in a Box, Cobalt Nitrate, 2 oz. bottle; Stoppered Bottles to Contain Test Solutions, 2 oz. size, labelled but empty (8); Corked Bottles, with Wide Mouths, to Contain Dry Tests, 1 oz. size, labelled, but empty (7).

SET C—REAGENTS.

INDICATING TESTS.

Sodium Carbonate, Ammonia, Ammonia Molybdate, Sulphuric Acid, Concent., Hydrochloric Acid, Potassium Hydrate, Potassium Ferricyanide, Barium Nitrate, Silver Nitrate, Calcium Chloride, Nitric Acid, Lead Nitrate.

CONFIRMING TESTS.

Potassium Chromate, Potassium Bichromate, Potassium Ferrocyanide, Potassium Antimoniate, Calcium Sulphate, Platinum Chloride, 5°, ¼ oz.; Gold Chloride, ¼ oz.; Gold Test in Dry State, Calcium Sulphide, Potassium Bisulphate, Ferrous Sulphate, Manganese Peroxide, Stannous Chloride, Copper Sulphate, Lead Acetate, Magnesium Sulphate, Sodium Chloride.

THE COMPLETE SETS A, B AND C, PRICE $30 00.

A SET OF APPARATUS AND CHEMICALS,

To illustrate Prof. Roscoe's Primer of Chemistry, which explains the fundamental principles in an easy and pleasant manner, well illustrated. Price of set complete, $35 00.

EXP. 1. Taper with wire holder.

EXP. 3. Glass tube containing a taper, with U tube for holding the caustic soda, and rubber tubing to connect with the aspirator.

Pair of hand scales with brass pans and weights from 2 oz. downward, in oak box.

EXP. 5. A 2 oz. glass flask, iron tripod stand, Bunsen's burner, with one yard of rubber tubing.

(This will be replaced by a spirit lamp and 1 pint of wood alcohol when desired.)

EXP. 6. A bell jar; capsule to contain the phosphorus.

EXP. 12. Apparatus for decomposing water by electricity, with two collecting tubes and wire to suspend them.

A 4-cell Bunsen's battery, with wires.

EXP. 14. Glass mortar and pestle, gas esprouvette.

EXP. 15. Flask etc., for generating hydrogen, stoneware pneumatic trough, with beehive shelf.

Four wide mouthed gas collecting bottles, pint size.

Three stoneware gas trays.

EXP. 20. A pint flask, wash bottle, two U shaped calcium chloride tubes and a hard glass tube to contain the copper oxide.

EXP. 21. Two 8 oz. stoppered glass retorts, a retort stand, with three rings and a clamp for test tubes, etc.

EXP. 23. A 16 oz. porcelain evaporating dish and a 4 oz. evaporating dish.

EXP. 25. Two 3 inch glass funnels, 100 filter papers.

EXP. 31. A horseshoe magnet.

EXP. 32. A palette knife.

EXP. 37. A piece of iron wire gauze, 6 inch square.

EXP. 42. Iron tray or sand bath.

EXP. 44. One dozen 5 inch test tubes, test tube holder, test tube stand for twelve tubes.

One blowpipe, two files (round and triangular).

Half a pound of glass tubing, 2 dozen spare corks.

Four lbs. Sulphuric Acid, 3 lbs. Nitric Acid, 2 lbs. Hydrochloric Acid, 1 pint Lime Water, 4 oz. Ammonia Solution, 4 oz. Caustic Potash, 4 oz. Sodium Carbonate, 4 oz. Potassium Chromate, 4 oz. Potassium Ferrocyanide, 4 oz. Silver Nitrate, 4 oz. Litmus, 4 oz. Indigo, 8 oz. Calcium Chloride, 8 oz. Marble, 8 oz. Iron Filings, 4 oz. Lime, 4 oz. Gypsum, 4 oz. Stourbridge Clay, 4 oz. Bleaching Powder, 1 lb. Manganese Dioxide, 4 oz. Soda Crystals, 4 oz. Alum, 4 oz. Sulphur Roll, 4 oz. Sulphur flour, 4 oz. Potassium Nitrate, 2 oz. Zinc, 2 oz. Copper Turnings, 2 oz. Copper Oxide, 2 oz. Copper Sulphate, 2 oz. Antimony, 2 oz. Mercury, 2 oz. Lead Acetate, 2 oz. Castor Oil, 2 oz. Caustic Soda (solid), 1 oz. Sodium Carbonate Anhydrous, 1 oz. Phosphorus Yellow, ½ oz. Phosphorus Red, ½ oz. Tin Oxide, ½ oz. Mercury Oxide, 1 dram Potassium, 1 dram Sodium, 6 leaves Gold Leaf, ½ yard Magnesium Ribbon, 1 Book Litmus Paper, 1 piece Charcoal.

Forty-three bottles (various) to contain the above chemicals and preparations.

SCALES PRICE LIST.

5001. Druggists' Scales, with Wood Box, Marble Top and Brass Pans.

	Price.
No. 1. 26 inch Box, 12 inch Pans, 30 pounds capacity	$39 00
" 2. 20 " 9 " 20 "	28 00
" 3. 18 " 8 " 10 "	23 00
" 4. 15 " 7 " 4 "	20 00

5002. Druggists' Scales, with Marble Top, Metallic Sides, Bronze Edges, Brass Pans.

	Price.
No. 1. 10½ inch Pans, 44 pounds capacity	$50 00
" 2. 9½ " 33 "	43 50
" 3. 7¾ " 18 "	32 00
" 4. 6½ " 4½ "	23 00
" 5. 5½ " 2½ "	20 00

5003 Brass Weights in Block, Avoirdupois.

	With Open Block.	With Cov'd Block.
Capacity, 4 pounds to $\frac{1}{16}$ ounce	Price, $16 00	$18 00
" 2 " $\frac{1}{16}$ "	" 10 50	12 00
" 1 " $\frac{1}{16}$ "	" 7 00	8 00

Single Weights. Separate from Full Sets.

Capacity $\frac{1}{16}$ ounce	Price each, $ 25
" ⅛ "	" 25
" ¼ "	" 35
" ½ "	" 50
" 1 "	" 65
" 2 "	" 75
" 4 "	" 85
" 8 "	" 1 15
" 1 pound	" 1 50
" 2 "	" 2 50
" 4 "	" 4 00
" 8 "	" 7 50

5004. Brass Weights in Block, Troy.

Capacity.	With Open Block.	With Cov'd Block.
500 ounces down	Price, $68 00	$72 00
300 "	" 50 00	54 00
200 "	" 36 00	40 00
100 "	" 25 00	29 00
50 "	" 20 00	23 00
30 "	" 15 00	18 00
20 "	" 12 00	15 00
10 "	" 10 00	12 00
5 "	" 8 00	10 00

5005. Bank Scale, with Metal Base.

No. 1. Capacity 100 oz	Price, without weights,	$140 00
" 2. " 300 oz	" " "	330 00

5006. BANK SCALE, with Brass Beam, Brass Column, Mounted on Wood Box
Capacity 100 ounces....... ....Price, without weights, $85 00

5007. BRASS CUP WEIGHTS, Troy.

Capacity 64 oz. down.......... ....Price,		$10 00
" 32 "	"	6 75
" 16 "	"	4 00
" 8 "	"	2 50
" 4 "	"	1 20
" 2 "	"	85
" 1 "	"	70
" ½ "	"	60
Sealed Troy Pennyweights....... ....Per set,		40
" Scruples and Drachms................................	"	40
" Grain Weights....	"	30

5008. JEWELERS' AND BROKERS' SCALES, very finely adjusted.

Description.	No.	Diam. of Pans.	Length of Beam.	Length of Box.	Weights.	Price
Brass Column, Brass Beam, Brass Pans and Chains, and Wood Box with Drawer, sealed Troy Cup Weights, dwts. and grns. complete,	0.	4 in.	7 in.	12 in.	8 oz	$13 50
	1.	4½ "	8 "	13½ "	8 "	15 50
	2.	5 "	9 "	15 "	16 "	18 00
	3.	6 "	10 "	17½ "	32 "	23 00
	4.	7½ "	12 "	20 "	32 "	27 50
	5.	8 "	15 "	24 "	64 "	35 50
	6.	10½ "	20 "	33 "	128 "	77 00

5009. FRENCH GOLD SCALES, Mounted on Box.

	Length of Beam.	Length of Box.	Price.
No. 24..............................	5½ inches.	9½ inches.	$5 50
" 32.......	7½ "	12½ "	7 70
" 35...........................	8½ "	14 "	9 00

5012. STANDARD YARD MEASURE.

Description.	Without Case.	With Case.
All Brass........	$18 00	$22 00

5013. PRESCRIPTION SCALE WITH GLASS CASE AND GLASS BOTTOM.

	Length of Beam.	Price.
No. 1...........................	12 inches	$ 35 00
" 2...........................	10 "	33 00
" 3.......	8 "	32 00

5014. SAMPLING SCALE, length of beam 6 inches........ .... 7 00

5015. PRESCRIPTION SCALES. PLAIN TOP—ALL BRASS.

	Length of Beam.	Price.
No. 3........	8 inches	$ 9 00
" 4...........................	7 "	8 00
" 6...........................	6 "	7 00

5016. PRESCRIPTION SCALES, WITH LEVER, MOUNTED ON MARBLE SLAB.

	Length of Beam.		Brass.	Glass Case.
No. 1...........................	12 inches.........	price,	$16 50	$30 00
" 2.............	10 "	"	14 00	27 00
" 3...........................	8 "	"	11 00	22 00

5017. Prescription Scales with Lever, Mounted on Box with Marble Slab.

	Length of Beam.		Brass.	Silver-plated.
No. 1	12 inches	price,	$22 00	$28 00
" 2	10 "	"	16 50	20 00
" 3	8 "	"	13 50	15 50

5018. Yarn Scales for Runs
5018*. Yarn Scales for Worsted Numbers } $8 00 to $45 00
5018**. Yarn Scales for Cotton Numbers

These Scales have one shell and beam weighted to show the size of yarn by the number of yards required to balance it.

5021. Weights in sets for woolen, worsted and cotton yarn, per set each............................brass, $2 00; nickle-plated, $3 50

These weights may be used with any fine balance scales.

5022. Weights to determine the weight of a yard of goods from a small sample. Full instructions given with the weights..$5 00 to $10 00

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FOR DESIGNS TO BE COPIED, MUSIC, BOOKS, ETC.

1. Polished Folding Easel, 14 inch long, 7 inch high, folded only 7 inch long, 1¼ inch square, each.. $ 50
2. Polished Folding Easel, 18 inch long, 9 inch high, folded only 9 inch long, 1⅜ inch square, each.. 60
3. Polished Folding Easel, 18 inch long, 9 inch high without top, only 9 inch long, 1⅜ x 1½ inch square, each.. 75
4. Fine Polished Folding Easel, 18 inch long x 9 inch high without top, folded only 9 inch long, 1⅜ x 1½ inch square, each................ 1 00
5. do. do. fine of Rosewood, do. do. do. each,.... 1 75

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Port Folios, School.

Size	11 x 16	14 x 18	16 x 22	19 x 25	22 x 30
Each	$ 60	$ 80	$1 00	$1 25	$1 75

Port Folios, Cloth Back and Corners.

Size	11 x 16	14 x 18	16 x 22	19 x 25	22 x 30
Each	$ 80	$1 10	$1 40	$2 00	$2 50

Port Folios, Fine Strongest Board, Leather Back and Corners.

Size	14 x 18	16 x 22	19 x 25	22 x 30	26 x 36	32 x 42
Each	$2 00	$2 50	$3 00	$4 50	$6 00	$7 50

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To furnish this specialty in all its varieties, at prices to defy competition, has cost us a deal of pains, but our coutracts for paper and ruling are now such that we can furnish design paper cheaper than any one else without doing ourselves an

injustice or resorting to the tricks of trade so common in this particular class of goods. Our prices are lower than those of any other reliable house that we know of. This fact, however, is not due to the desire to cut trade prices, but because we have good reason to believe that when our papers have been tried, individual orders will be larger than heretofore, when almost every purchase was a new experiment. For single sheets or broken quires we are obliged to charge New York market prices—10 to 20 cents per sheet of ruled paper, 15 to 25 cents per sheet of printed paper. Printed paper can be furnished by the yard. Prices of design paper in the roll are not included in the price list, as that form meets but little favor. Pads, on the contrary, are not put in, because we make those up to order at a very little advance upon the price of loose paper, it being a process always in hand and quickly done. Any designer who uses slips of any particular size will find the pads most convenient and cheapest, because they allow little waste if proper sizes are used.

In ordering new kinds and styles of paper, a hand-ruled sample should be inclosed. On large orders, two colors of ink may be arranged in various ways without extra cost for ruling. Additional colors cause extra expense, and changes in small orders are very expensive. Printed papers can be made in more than one color only at a great cost.

What are termed plaided papers in two or more colors, ruled to order: 8 blue lines, 8 red lines; 8 blue lines, 4 red lines; 4 blue lines, 8 red lines; 12 blue lines, 4 red lines; 4 blue lines, 12 red lines; 4 blue lines, 4 red lines. Other proportions cost a little extra, according to size of order.

Draft Blanks for woolen mills made to order, and furnished in loose sheets, pads or books. The latter can be made like a stub-check book. Tracing paper ruled or printed to match all our regular styles of paper; a great convenience for copying drafts. Prices double that of common design paper.

DESIGN PAPER—PRICE LIST.

	HEAVY.				EXTRA HEAVY.					
	Ruled. One side.		Ruled. Both sides.		Ruled. One side.		Ruled Both sides.		Printed. One side.	Printed. Both sides.
Size of Sheet.	Per Q.	Per R.	Per Q.	Per R.	Per Q.	Per R.	Per Q.	Per R.	Per Q.	Per Q.
14 x 17	.50	6.00	.60	7.50	.60	7.50	.70	8.75	4.00	4.50
16 x 21	.60	7.50	.70	8.75	.75	9.00	.90	10.50	4.50	5 00
18 x 23	.75	9.00	.90	10.50	.90	11.75	1.00	12.75	5.00	5.50

Above prices are for one or two colors on the ruled paper, one color on the printed. More colors increase the price on orders of less than four reams. With one color the squares are blocked off by heavier lines. In two colors the second color is used for blocking in a heavy line; ½ inch block may contain 2, 4 or 5 squares per block; ¾ inch blocks may contain 4, 5, 6, 8, 10 or 12 squares per block; ⅞ and 1 inch blocks may contain 4, 5, 6, 8, 10, 12 or 16 squares per block. On the printed papers ½ inch blocks contain 4, 5 or 8 squares per block. Samples of design paper sent on receipt of postage.

The above are our regular styles, but not all kept in stock. Of those not in stock, any order of not less than one quire will be promptly ruled or printed without extra charge. Other styles can also be furnished very promptly.

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1. Whatman's Drawing Papers. Hand-made.

H.P. signifies Hot Pressed, and has a smooth surface.
N. " Not Hot Pressed, and has a finely grained surface.
R. " Rough, and has a coarsely grained surface.
H.P. Paper is mostly used for pencil and very fine line-drawings.
N. Paper is used for general purposes and water-color drawing.
R. Paper for very bold drawing and sketching.

				Selected Best.	Retree or Second Quality.
Cap	13x17 inch	H.P. N.,	per quire,	$ 80	$ 70
Demy	15x20 "	"	"	1 00	85
Medium	17x22 "	"	"	1 50	1 25
Royal	19x24 "	"	"	1 85	1 60
Super Royal	19x27 "	"	"	2 40	2 00
Imperial	22x30 "	"	"	3 50	3 00
Atlas	26x34 "	"	"	5 00	4 50
Double Elephant	27x40 "	"	"	6 00	5 50
Antiquarian	31x53 "	"	"	30 00	18 00
"	31x53 "	"	per sheet,	1 75	90
Griffin Antiquarian	31x53 "	N.,	"	3 00	
Imperial	22x30 "	R.,	per quire,	3 75	per sheet, 18
Double Elephant,	27x40 "	"	"	7 50	" 35

2. Whatman's Extra Thick Drawing Papers.

Royal	19x24 inch	N.,	per quire,	$4 75	per sheet, 55
Imperial	22x30 "	H.P. N. R.	"	9 00	" 45
Double Elephant	27x40 "	N. R.	"	14 00	" 75

2½. Imitation Creswick Drawing Papers.

Imperial	22x30 inch	N.,	"	$7 50	per sheet, 38

Whatman's Drawing Papers, "Selected Best" and "Retree," are both of the same quality, as they are made of the same material. The "Selected Best" quality are the best sheets, without imperfections. Both bear the impression: "Whatman" or "Whatman Turkey Mills."

3. Antique or Eggshell Papers, best quality.

Demy	15x20 inch,	per quire,	$ 80
Medium	17x22 "	"	1 10
Royal	19x24 "	"	1 40
Imperial	22x30 "	"	2 25

4, Machine Papers, good quality, used in Schools for Pencil and Crayon Drawings.

Cap	14x17 inch,	per quire,	40
Demy	15x20 "	"	60
Medium	17x22 "	"	75
Royal	19x24 "	"	1 00
Super Royal	19x27 "	"	1 20
Imperial	22x30 "	"	1 50
Double Elephant	27x40 "	"	2 50

5. J. D. HARDING'S PAPERS, for Water Color Sketching.

Imperial	22x30 inch,	per quire,	$4 00
" extra thick,	22x30 "	"	8 00

6. ENGLISH TINTED CRAYON PAPERS.

Imperial	22x30 inch, 12 different tints	per quire,	$3 00
Double Elephant	27x40 " 6 " "	"	4 50

7. GERMAN TINTED CRAYON PAPERS, Rough Grain, 12 different tints.

Royal	18½x24½ inch	per quire,	$1 60

8. FRENCH TINTED CRAYON PAPERS, Slight Grain, 12 different tints.

Royal	19x25 inch	per quire,	$1 25

9. FRENCH TINTED CHARCOAL PAPERS, 12 different tints.

Royal	19x25 inch	per quire,	75

10. ENGLISH WHITE BRISTOL BOARDS, Smooth Surface.

			2 Sheets.	3 Sheets.	4 Sheets.
Cap	12¾x16½ inch	per doz.,	$ 65	$1 00	$1 35
Demy	14½x18½ "	"	1 00	1 50	1 80
Medium	16½x20¾ "	"	1 35	1 80	2 50
Royal	18 x22½ "	"	1 75	2 60	3 50

11. FRENCH WHITE BRISTOL BOARDS, Slight Grain.

Cap	12½x16½ inch	per doz.,	65	80	1 00
Demy	15x¼19½ "	"	1 00	1 30	1 65
Medium	16¾x20¾ "	"	1 25	1 50	1 90
Royal	19 x24¾ "	"	1 50	2 00	2 50
Imperial	21½x28 "	"	1 75	2 25	2 75
				Per dozen.	Per sheet.
Colombier	24 x34½ "	Extra fine, 4 sheets		$ 7 00	$ 70
Double Elephant	28¾x41½ "	" "		10 00	1 00

12. FRENCH TINTED BRISTOL BOARDS, thin, 12 different tints.

Royal	19x24½ inch	per doz.,	$1 25

13. FRENCH TINTED BRISTOL BOARDS, thick, 12 different tints.

Royal	19x24½ inch	per doz.,	$2 25

14. BOND PAPERS, for Tracings, very tough.

	16 x 21.	19 x 24.	19 x 30.
Per 100 sheets	$3 25	$4 00	$5 00
Per quire	1 10	1 20	1 40

15. ENGLISH PARCHMENT, best quality.

	14 x 18	16 x 20	18 x 24	21½ x 29½	23 x 31 inch.
Per dozen	$5 50	$7 20	$9 00	$13 00	$14 00
Per sheet	50	70	90	1 30	1 40

(23 x 31 inch is the size for English Patent Drawings and Specifications.)

15½. ENGLISH GOVERNMENT PATENT PREAMBLES, Legal Blanks.

Printed on Parchment	each,	$1 50
" " Paper	"	15

16. Gelatin or Glass Paper.

	Thin.	Medium.	Thick.
13 x 19 .... per sheet,	$ 30	$ 35	$ 45

17. Transfer Papers, Blue, Red, Black and Black-lead.
    11½ x 18½ inch .... per doz., $1 50 Per sheet, $ 15

18. White Mounting Boards.
    22 x 28 inch, according to thickness.

	No. 1.	No. 2.	No. 3.	No. 4.
Per sheet	$ 10	$ 12	$ 15	$ 20

19. Chagrin Boards, for Passepartouts, white and tinted.
    22 x 28 inch .... per sheet, $ 15

20. Chagrin Papers, for Passepartouts, white and tinted.
    22 x 28 inch .... per sheet, $ 10

DRAWING PAPERS CONTINUOUS IN ROLLS.

The four different qualities of white Roll Drawing Paper described below answer fully what Architects, Engineers and Draughtsmen may require. By ordering the papers according to the description given, customers will not fail to receive exactly what suits their purpose.

31. A very tough and pliable paper of a yellowish white hue, matchless for working drawings used out-of-doors or in the workshop, where drawings are under continuous rough handling. This paper has a slightly grained surface similar to Whatman's "not pressed;" it takes color well and stands erasing to the greatest extent.

33. An almost pure white paper of good quality with slightly grained surface, suitable for work in Ink, Color, Pencil or Crayon. It is used for general office-work, preliminary drawings, and to a great extent for school purposes. This paper is generally known under the name of **"German Drawing Paper,"** but is of far better quality than most of those papers imported to this country. Our paper No. 4 is the same article in sheets.

36–37. Good, well sized and tough papers of a yellowish white tint, suitable for fine drawings; it has a grain similar to Whatman's "not pressed," but is somewhat smoother. It will take ink and color perfectly well.

38 to 41. **Paragon.** These papers, of which Keuffel & Esser have exclusive control in this country, were introduced by them within the last two years. They have, in this very short space of time, taken the lead of all drawing papers, and wherever they have been used are acknowledged to be the best.

The Paragon Papers have no equal in Uniformity of Grain, Strength of Tissue, Toughness and Pliability, Sizing that will stand erasing and yet receive ink and color perfectly well.

In consequence of the marvelous success of these papers, paper of similar appearance is offered and sold as "Paragon;" we therefore caution our customers against all papers offered as "Paragon" which do not show on each border the water-mark "Paragon," the duly registered trade-mark.

We warrant the Paragon Paper and exchange all which does not prove as represented.

38, 39, 40, 40–2. Having a sand-grain or pebbled surface (Eggshell), are adapted to general drawing, either in lines or in wash ; they are also very desirable for water-color drawings, as the colors have a beautiful effect on the peculiar surface.

For Elevations, Perspectives and every kind of finished drawings no better paper can be found.

41. Has a grain like Whatman's ' not pressed" on one side ; the reverse is perfectly smooth, adapting it for drawings to be reproduced by photographic or any other process.

30. Detail Papers, extra tough, buff color, thin, medium, thick 36, 40, 44, 48, 54 inch wide, in rolls of 75 to 100 lbs.......... ....per lb. 14 to 16
According to thickness and width ....per yard. 10 to 25

				In rolls of 30 to 40 lbs. Per lb.	In rolls of 10 yards. Per roll.	Per yard.
31.	White Roll Drawing Papers, medium	62 inch wide,		.45	3 75	.40
33.	" "	36	"	.40	2 00	.25
	" "	42	"	.40	2 60	.30
	" "	56	"	.40	3 00	.35
36.	" "	55	"	.55	4 50	.50
37.	" thick,	55	"	.55	6 00	.70
38.	Paragon, thin rough,	58	"	.50	4 00	.45
39.	" medium rough,	42	"	.50	3 50	.40
	" "	58	"	.50	4 50	.50
40.	" thick rough,	58	"	.50	6 00	.75
40–2.	" extra thick rough,	58	"	.50	7 50	.90
41.	" medium smooth,	58	"	.50	4 50	.50
43.	Tinted Roll Drawing Papers, rough,	54	"	.50	4 00	.45
45.	Tinted Drab " thick, very good for detail drawings, with slight grain,	53 inch wide,		.50	4 50	.50

46. Steinbach's Solar Printing and Crayon Papers, 53 inches wide, in rolls of 10, 25 and 50 yards, per yard.................................. 50
46½. do. do. thick................................ 60

DRAWING PAPERS, WHITE.

Mounted on Muslin in Rolls of 10 Yards.

50. The same paper as described under No. 33.

51. This is a very thick paper of good quality and clear white color. The rough paper has a grain coarser than Whatman's "not pressed," the smooth paper has a finer grain.

52½, 52, 53, 52S. The same papers as described page 94. Nos. 38–41.

				Per roll.	Per yard.
50.	Best quality, medium thickness,	36	inch wide.............	$ 8 00	$ 90
	" "	42	"	9 00	1 00
	" "	54	"	11 25	1 25
51.	" thick, rough or smooth surface,	42	inch wide...	12 50	1 40
	"	54	" ...	15 00	1 75
52½.	Paragon, thin, rough	58	" ...	11 50	1 25
52.	" medium, rough	36	" ...	8 50	1 00
	" "	42	" ...	9 50	1 10

		Per roll.	Per yard.
52. Paragon, medium, rough,	58 inch wide...	$12 50	$1 40
52S. " medium, smooth	58 " ...	12 50	1 40
53. " thick rough	58 " ...	14 00	1 60

54. Whatman's Drawing Paper, mounted,

Royal.........18 x 24 inch, per sheet..................	40
Imperial.......22 x 30 " "	50
D'ble Elephant.27 x 40 " "	75
Antiquarian ...31 x 53 " "	1 50

Large pieces for City, County or State Maps mounted to order.

55. Paper cloth, very thin, smooth, 38 inch wide, per yard................ 50

Paper Cloth is a new article, made of muslin, to which the paper-pulp is applied. It is pliable and strong, either for drawing or printing purposes ; especially adapted for pocket maps, plans, time-tables, season tickets, etc.

TRACING OR VELLUM CLOTH.

Both Sides Glazed, and One Side Glazed the Other Dull, Suitable for Pencil-marks.

60. Sagar's Patent, white, in rolls of 24 yards.

	18,	30,	36,	42 inch wide.
Per roll,	$4 25	7 50	8 25	11 50

61. Imperial, white, in rolls of 24 yards.

	30,	36,	42 inch wide.
Per roll,	$7 50	8 25	11 50

TRACING PAPERS IN SHEETS.

63. French Vegetable, very tough and transparent.

Cap...............13x17 inch, thin..................	per quire,	1 20
Demy.............15x20 " "	"	1 50
Royal.............18x24 " " and thick..........	"	2 50
Imperial.......... 21x27 " " "	"	3 30
Double Elephant...27x38 " thin..................	"	9 00
64. French common, 20x30 inch, medium	"	1 50
" " 30x40 " "	"	3 00
66. Fine, glazed, very transparent and tough, 30x40 inch.......	"	4 50
67. Extra Stout, very tough, suitable for machinists, 30x40 inch,	"	4 50

TRACING PAPERS CONTINUOUS IN ROLLS.

	Per Roll.
70. French, best vegetable, very tough, 54 inch wide, in rolls of 22 yards,	$5 00
71. French common, 42 inch wide, in rolls of 22 yards....	3 50
72. German, very tough and transparent, 42 inch wide, in rolls of 20 yards,	4 20
73. German, very best, very tough and transparent, 54 inch wide, in rolls of 30 yards..	8 00

No.		Price.
74.	German, not prepared, for transferring, 54 inch wide, in rolls of 44 yards	$6 00
76.	Extra stout, very tough, suitable for machinists, 40 inch wide, in rolls of 20 yards	4 50
77.	Parchment Tracing Paper, very tough, 37 inch wide, in rolls of 20 yards	5 50
78.	Paragon Tracing Paper, very transparent, almost like glass, very tough, 56 inch wide, in rolls of 20 yards.	5 50

HELIOGRAPHIC OR BLUE PROCESS PAPER.

Paper chemically prepared to take copies from tracings by simple exposure to sunlight. Full directions furnished with the paper.

76. Continuous, 26½ inch wide, in rolls of 10 yards.............per roll, $5 00

79A.	In sheets, 26x40 inch	per quire, $12 00	per sheet,	60
	" 20x26 "	" 6 00	"	30

(Other sizes made to order.)

Photo Solution for preparing Heliographic Paper.............quart bottle, 4 00

Samples of Drawing Papers will be sent on application.

Sample Book of Drawing Papers.. 15

CROSS SECTION PAPERS.

Nos. 91, 92, 93 Printed in Orange, Blue or Green.

91.	Cross Section 8 feet to one inch, dimensions of engraving 16½ x 22 inch, per quire	$ 5 00
	per sheet	25
92.	Cross Section 10 x 10 to one inch, dimensions of engraving 16 x 20 inch, per quire	5 00
	per sheet	25
93.	Cross Section 5 x 5 to ½ inch, dimensions of engraving 16 x 20 inch, per quire	5 00
	per sheet	25
97.	Cross Section, 16 x 16 to one inch, continuous 24 inch wide, printed in orange, per yard	40
94.	Cross Section 5 x 5 to one inch, 16 x 21 ruled in blue, per quire	1 50
95.	" 10 x 10 " 16 x 21 " "	1 50
96.	" 8 x 8 " 16 x 21 " "	1 50
89.	" millimetre, 18 x 24, printed in orange, per sheet	25

PROFILE PAPERS.

PRINTED IN ORANGE OR GREEN.

No.		Price.
80.	Plate A, 15 x 42 inch, horizontal ruling 4, vertical ruling 20 to one inch, per quire	8 50
	per sheet	40
83.	Plate A, continuous, 22 inch wide, per yard	30
85.	" " 22 " mounted on cloth, per yard	75
81.	Plate B, 13½ x 42 inch, horizontal ruling 4, vertical ruling 30 to one inch, per quire	8 50
	per sheet	40
84.	Plate B, continuous, 22 inch wide, per yard	30
86.	" " 22 " mounted on cloth, per yard	75
82.	Plate C, 15 x 42 inch, horizontal ruling 5, vertical ruling 25 to one inch, per quire	8 50
	per sheet	40

ENGINEERS' FIELD BOOKS.

		Per Doz.
100.	Field Book, 4½x7½ inch, bound in leather, round corners, 80 leaves,	$6 00
101.	Transit Book, 4½x7½ inch, " " " "	6 00
102.	Level Book, 4x6½ inch, " " " "	4 50

DESIGN BOOKS.

LEATHER BACK, CLOTH SIDES OR BINDING. No. 2.

Size.	Pages.		Heavy.	Extra Heavy.
7 x 8½	240	Price,	$1 50	$2 00
8 x 10½	240	"	1 75	2 25
9 x 11½	240	"	2 25	2 75
9 x 14	480	"	5 00	6 00
11 x 16	480	"	6 00	8 00
12 x 18	480	"	8 00	10 00

The above prices are for Binding No. 2. We also bind in two other styles, No. 1 and No. 3. The prices in the former are 10 per cent. less, and in the latter 15 per cent. more than the above list. No. 1 is plain, but very substantial "marbled paper" sides. No. 3 has extra stout back, sides like No. 2, leather corners.

The superior merits of the No. 3 are most apparent on the larger sizes. Flexible covers are furnished at same price, but never kept on hand, as they are not ordered frequently enough.

Lettering in gold on sides or back costs a trifle extra, according to style and number of letters wanted. Above prices are all for design paper ruled alike on both sides; some other styles can be furnished at same price, but any additional expense will be charged extra. More leaves or larger pages increase the price

pro rata. More leaves and sizes just double the above in width, and same length, will be made to order, with no extra charge except that for the increase of paper, but odd sizes will cost more in proportion. Extra labor and waste of stock must all be paid for. Estimates cheerfully furnished.

NOTE.—Very wide leaves are meeting with much favor. They lay flat in whatever part the book is opened.

PATTERN OR SAMPLE BOOKS.

We furnish all the more popular Factory made Scrap and Invoice Books, which are often used for Pattern Books ; but the trade prices in these are so closely protected that we can offer our patrons no special inducement in them except the pains we take in selecting the goods, to avoid sending any that may be unserviceable or unsuitable. In regular Pattern Books we can, and do offer very material advantages. Our goods are expressly made for us by binders who have had work of this kind to do for years past. Their experience and our facilities for procuring first-class stock enable us to make our price list for the best work at rates far below those usually charged. Our price list includes only the goods of Messrs. Asa L. Shipman's Sons, besides our own manufacture. Cheaper goods will be made to order or procured from other parties and supplied at the lowest rates. Binding No. 1 throughout the entire list represents good, substantial binding, leather back, marbled paper sides. Binding No. 2, cloth sides, strong leather backs ; and No. 3, cloth sides and extra strong and durable backs.

PATTERN OR SAMPLE BOOKS.

LEATHER BACK AND CLOTH SIDES OR BINDING NO. 2.

Kind of Paper.			Pages.		Heavy Paper.	Extra Heavy Paper.
Manila,	size	7x8½,	240	Price,	$1 40	$1 60
White Book,	"	"	"	"	1 50	1 75
Bristol Board,	"	"	"	"	2 00	2 50
Card Board,	"	"	"	"	3 00	3 75
Mat Leaves,	"	"	"	"	5 00	6 00
Manila,	"	8x10½	"	"	1 60	2 10
White Book,	"	"	"	"	1 75	2 25
Bristol Board,	"	"	"	"	2 50	3 00
Card Board,	"	"	"	"	3 50	4 25
Mat Leaves,	"	"	"	"	6 00	7 00
Manila,	"	9x11½	"	"	2 00	2 50
White Book,	"	"	"	"	2 25	2 75
Bristol Board,	"	"	"	"	3 00	3 50
Card Board,	"	"	"	"	4 00	4 75
Mat Leaves,	"	"	"	"	6 50	7 50
Manila,	"	9x14	480	"	4 50	5 75
White Book,	"	"	"	"	5 00	6 00
Bristol Board,	"	"	"	"	6 00	7 00

						Heavy Paper.	Extra Heavy Paper.
Card Board,	size	9x14	480	....	Price,	$7 00	$8 00
Mat Leaves,	"	"	"	....	"	8 00	9 00
Manila,	"	11x16	"	....	"	5 50	7 50
White Book,	"	"	"	....	"	6 00	8 00
Bristol Board,	"	"	"	....	"	8 00	9 00
Card Board,	"	"	"	....	"	10 00	11 00
Mat Leaves,	"	"	"	....	"	12 00	13 00
Manila,	"	12x18	"	....	"	7 25	9 00
White Book,	"	"	"	....	"	8 00	10 00
Bristol Board,	"	"	"	....	"	10 00	11 00
Card Board,	"	"	"	....	"	12 00	13 00
Mat Leaves,	"	"	"	....	"	14 00	15 00

Lettering on the back costs a trifle extra.

Deduct 10 per cent. from above prices for binding No. 1. Add 15 per cent. for binding No. 3.

All the papers used in these books are heavily calendered, and any part of them may be written upon with ink. Especially do we call attention to the amount of erasure that our papers will endure.

SHIPMAN'S PATENT SCRAP BOOKS.

MANILA PAPER.

Dark Blue Sheep Backs and Corners, Raised Bands and Spring Backs.

	Size.	Pages.	Description.	No.	Price per Book.
Demy......................	10½ x 15	236	Paper Sides	1	$1 85
"	"	236	Cloth Sides	2	2 03
"	"	344	Paper Sides	3	2 31
"	"	344	Cloth Sides	4	2 53
"	"	464	Paper Sides	5	3 01
"	"	464	Cloth Sides	6	3 25
"	11 x 16	236	Paper Sides	7	2 05
"	"	236	Cloth Sides	8	2 25
"	"	344	Paper Sides	9	2 61
"	"	344	Cloth Sides	10	2 77
Medium....................	12½ x 17½	236	Paper Sides	11	2 25
"	"	236	Cloth Sides	12	2 37
"	"	344	Paper Sides	15	2 76
"	"	344	Cloth Sides	16	2 98
"	"	464	Paper Sides	015	3 67
"	"	464	Cloth Sides	016	3 87

INVOICE BOOKS.

MANILA PAPER, INDEXED AND PAGED. DARK BLUE SHEEP BACKS AND CORNERS, RAISED BANDS AND SPRING BACKS. Can be used for Pattern Books.

	Size.	Pages.	Description.	No.	Price per Book.
Demy	10½ x 15	236	Paper Sides	70	$2 35
"	"	350	"	71	2 89
"	11 x 16	236	"	72	2 55
"	"	350	"	73	3 18

MANILA PAPER, RULED, PAGED AND INDEXED. DARK BLUE SHEEP BACKS AND CORNERS, RAISED BANDS AND SPRING BACKS.

	Size.	Pages.	Description.	No.	Price per Book.
Demy	11 x 16	300	Paper Sides	74	$3 20
"	"	400	"	75	3 82
Medium	12½ x 17½	236	"	13	2 90
"	"	236	Cloth Sides	14	3 10
"	"	350	Paper Sides	17	3 72
"	"	350	Cloth Sides	18	3 92
"	"	470	Paper Sides	19	4 95
"	"	470	Cloth Sides	20	5 15
	Russia Back and Corners.				
"	"	500	Paper Sides	B	5 70
	Full Rough Sheep.				
"	"	500		C	6 20

Nos. 70, 71, 72, 73, 74, 75, 13, 17, 19 also in full Duck, at same prices, and numbered 70 D, etc.

MANILA PAPER. DARK BLUE SHEEP BACKS AND CORNERS, SPRING BACKS.

	Size.	Pages.	Description.	No.	Price per Book.
Letter	8½ x 11	144	Paper Sides	21M	$1 04
"	"	192	"	22M	1 24
Packet Post	10 x 12	144	Paper Sides	23M	1 14
"	"	144	Cloth Sides	24M	1 28
"	"	192	Paper Sides	25M	1 39
"	"	192	Cloth Sides	26M	1 51
"	"	300	Paper Sides	27M	1 82
Note	6½ x 9	150	"	A	88

MANILA PAPER. AMERICAN RUSSIA BACKS AND CORNERS.

	Size.	Pages.	Description.	No.	Price per Book.
Packet Post	10 x 12	300	Paper Sides	28M	$2 23
"	"	300	Cloth Sides	29M	2 37

HEAVY PAPER, ASSORTED COLORS. DARK BLUE SHEEP BACKS AND CORNERS, SPRING BACKS.

	Size.	Pages.	Description.	No.	Price per Book.
Packet Post	10 x 12	96	Paper Sides	21	$1 12
"	"	96	Cloth Sides	22	1 19

	Size.	Pages.	Description.	No.	Price per Book.
Packet Post	10 x 12	144	Paper Sides	23	$1 34
"	"	144	Cloth Sides	24	1 47
"	"	192	Paper Sides	25	1 63
"	"	192	Cloth Sides	26	1 73
Cap	9½ x 13	192	Cloth Sides	29	1 93
"	"	144	Cloth Sides	029	1 63

HERBARIUMS.

WHITE PAPER. DARK BLUE SHEEP BACKS AND CORNERS, SPRING BACKS.
Can be used for Pattern Books.

	Size.	Pages.	Description.	No.	Price per Book.
Letter	8½ x 11	80	Paper Sides	31	$1 16
"	"	80	Cloth Sides	32	1 28
"	"	120	Paper Sides	33	1 45
"	"	120	Cloth Sides	34	1 57
Cap	9½ x 13	80	Paper Sides	35	1 24
"	"	80	Cloth Sides	36	1 36
"	"	120	Paper Sides	37	1 53
"	"	120	Cloth Sides	38	1 73
Note	6½ x 9	150	Paper Sides	Aw	96

DRUGGISTS' PRESCRIPTION BOOKS.

MANILA PAPER. DARK BLUE SHEEP BACKS AND CORNERS, SPRING BACKS.
Can be used for Pattern Books.

	Size.	Pages.	Description.	No.	Price per Book.
Packet Post	10 x 12	300	Paper Sides	45	$1 91
Demy	10½ x 15	236	Paper Sides	46	2 06
"	"	344	Paper Sides	47	2 52
Medium	12½ x 17½	464	Cloth Sides	48	4 10

OBLONG, WHITE PAPER.

Size.		Pages.	Description.	No.	Price per Book.
8 x 11½	Oblong	150	Half Roan, Cloth Sides	82	$1 50
"	"	150	Half Morocco, Cloth Sides	83	1 72
9 x 12½	"	150	Half Roan, Cloth Sides	84	1 72
"	"	150	Half Morocco, Cloth Sides	85	2 00
11 x 15½	"	200	Half Morocco, Cloth Sides	86	2 70

COPYING BOOKS.

Best French Linen Paper, Blue Sheep Backs and Corners, Cloth Sides, Filleted on Sides, Lettered on the Back and Indexed.

Size, 9x11....... 300 Leaves....No. 1................Price per book, $1 70
" .... 500 " .... " 2................ " 2 20

Size, 9x11	700 Leaves	No. 3	Price per book,	$2 70
"	900 "	" 4	"	3 50
Size, 10x12	300 "	" 5	"	1 90
"	500 "	" 6	"	2 40
"	700 "	" 7	"	3 00
"	900 "	" 8	"	3 60
"	1000 "	" X	"	4 20
Size, 10x14	300 "	" 9	"	2 30
"	500 "	" 10	"	3 15
"	700 "	" 11	"	4 05
"	900 "	" 12	"	4 85
Size, 6x9,	300 "	" 13	"	1 30
"	500 "	" 14	"	1 65

Any size or style of Binding made to order.

TRANSFER BOOKS.

Manufactured by Asa L. Shipman's Sons.

200	$4\frac{3}{4}$x$7\frac{1}{2}$	(Oblong), full cloth, 200 leaves	Price,	$1 00
201	6x9	Roan back and corners, cloth sides, 200 leaves	"	1 75
202	$7\frac{3}{4}$x10	" " " 200 "	"	2 00
203	"	" " " 300 "	"	2 50
204	"	" " " 500 "	"	3 50
205	"	" " " 700 "	"	4 25
206	$9\frac{1}{2}$x11	" " " 300 "	"	3 50
207	"	" " " 500 "	"	4 50

Prices include two pieces of Carbon and a Stylus.

Carbon and Manifold Paper furnished by the ream or quire.

SHIPMAN'S PATENT LETTER AND INVOICE FILES.

ADHESIVE.

Size.				Cloth Sides.
9x11	250 Leaves	For Letters	per doz.,	$12 00
"	500 "	" "	"	19 50
10x12	250 "	" "	"	12 50
"	500 "	" "	"	20 00
$8\frac{1}{2}$x9	250 "	" Bath	"	10 44
9x13	250 "	" Invoices	'	12 00
"	500 "	" "	"	19 50
9x15	250 "	" "	"	15 00
"	500 "	" "	"	22 80
7x11	250 "	" Bills, Oblong	"	8 40
"	500 "	" "	"	15 00
$12\frac{1}{2}$x$17\frac{1}{2}$	250 "	" Manifests, &c.	"	23 00
"	500 "	" "	"	32 50
11x15	250 "	" Prices Current	"	15 60

Size.	Leaves				Cloth Sides.
11x15	500 Leaves	For	Prices Current	per doz.,	$24 00
6x9	250 "	"	Note Letters	"	10 20
"	500 "	"	"	"	15 00
"	250 "	"	Telegrams, Oblong	"	8 40
10x12	250 "	"	American Russia Backs	"	15 00
7x6½	150 "	"	Postal Cards	"	7 20
Size.					**Paper Sides.**
9x11	250 Leaves	For	Letters	per doz.,	$11 50
"	500 "	"	"	"	19 00
10x12	250 "	"	"	"	11 50
"	500 "	"	"	"	19 00
9x13	250 "	"	Invoices	"	11 50
"	500 "	"	"	"	19 00

The above bound in full duck at the same price as cloth sides.

NON-ADHESIVE.

Size.	Leaves	No.		Cloth Sides.
9x11	250 Leaves	No. 101	per doz.,	$10 80
"	500 "	" 102	"	17 50
10x12	250 "	" 103	"	10 80
"	500 "	" 104	"	17 50
9x13	250 "	" 105	"	10 80
"	500 "	" 106	"	17 50
9x15	250 "	" 107	"	13 50
"	500 "	" 108	"	20 70
12½x17½	250 "	" 109	"	22 70
"	500 "	" 110	"	28 50

Parties desiring the Non-Adhesive File, please order by the numbers to avoid confusion.

Any size File made to order at short notice.

SHIPMAN'S STICKALINE.

This article is a substitute for Mucilage or Paste, combining the adhesiveness of the one with the neatness and cleanliness of the other. Wherever it has been used it has become an indispensable article, either in the Home Library, Office or Workshop. It especially commends itself, as it does not stain or soil pictures, clippings, covers, fabrics, torn or loose leaves in books. Its composition enables it to retain its sweetness and adhesive properties for months and years, and a trial will convince any one that it is the best article in the market for any purpose for which mucilage or paste is used.

No. 1.	Half Pint, cork stopper	per doz.,	$3 00
" 2.	" glass jar	"	3 00
" 3.	" screw top jar	"	3 60
" 4.	Pints, cork stopper	"	4 50
" 5.	Quarts, "	"	8 00

Warranted not to mould or be injured by freezing.

Liberal discount to the trade.

Bottom discount given to wholesale dealers.

PENNELL'S BLACK WRITING INK.

Permanent Black Ink, Octagon Stands	per gross,	$5	00
" " Square "	"	4	00
" " 8 ounce	per doz.,	1	50
" " Pints	"	2	50
" " Quarts	"	5	00

PENNELL'S COPYING INK.

Stands	per doz.,	$	75
8 ounce	"	2	00
Pints	"	3	50
Quarts	"	6	00

In ordering be sure to state the fact if Shipman's goods are wanted.

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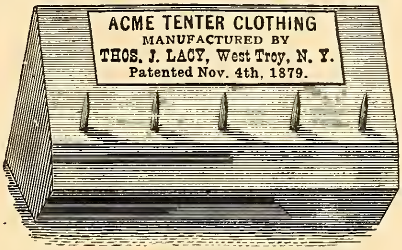

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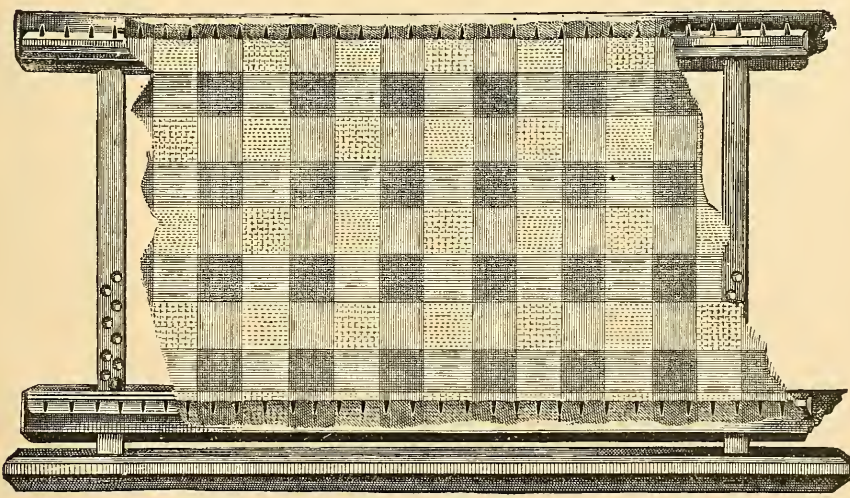

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